Edge Hill University

# Teachers' Awareness of and Attitude to Research, School Research Culture, and Student Achievement. A Pragmatic Examination.


Scott Clarke

Edge Hill University


This thesis is submitted to the Faculty of Education, Edge Hill University, in partial fulfilment of the requirements for the degree of Doctor of Philosophy

September 2020

Word count - 74469

## Table of Contents

## Tables & Figures

### Tables



### Figures

## Appendices

## Abstract

In England, there is a contentious drive pushing schools, and teachers within those schools, to provide research-informed practice. Proponents of research-informed education propose that educational research should be communicated to schools where it can be read by teachers and incorporated into their practice to improve teaching quality and subsequently student achievement.

Using a larger sample than seen in most comparable literature, this investigation contributes to available literature in the following ways. Teachers' knowledge of a broad variety of well-established educational research findings are identified. The extent to which secondary schools have developed a research-informed culture is examined using Cain's (2018) framework. Perhaps, most pertinently for researchers and policy-makers relationships between research engagement and student achievement are also explored. Though predominantly quantitative and survey-based, multimethods were utilised. Thirty-eight mainstream, state-funded secondary schools encompassing 426 teachers participated. Two surveys were distributed; the first was distributed to the person responsible for teachers' CPD in each participating school to identify the extent to which that institution has, and is working towards, developing the dimensions of a research-informed culture detailed in Cain's (2018) framework. The second survey was distributed to teachers across all participating schools to identify: a) their awareness of well-established educational research findings, b) their perceptions of the usefulness of educational research findings for guiding teaching practice, and c) steps taken at an individual level to maintain currency with educational research.

Analyses revealed that most schools place substantial importance on developing a research-informed culture but are more reserved in implementations to reach that goal. Generally, teachers' ability to identify well-established educational research findings is similar to that expected by chance. No statistical relationship was identified between school research-informed culture, teachers' awareness of well-established educational research findings, and student achievement. Theoretical and methodological implications are discussed, along with implications for educational policy-makers and stake-holders.

**Key words:** research-informed education, educational research, research-informed teaching practice, student achievement, research-based knowledge.

**Acknowledgements**

I would firstly like to thank Edge Hill University for accepting my application to become a Graduate Teaching Assistant because this scheme has provided outstanding academic and professional opportunities. Without that scheme, it is unlikely that I would have been able to proceed with PhD study. I would also like to thank my colleagues in the Further Education & Training team at Edge Hill University for being very supportive and helping me to balance my teaching and research responsibilities during my tenure as a Graduate Teaching Assistant.

I would also like to express my gratitude to my supervisors, Professor Tim Cain, Professor Victor van Daal, and Dr David Allan for their invaluable contributions and direction throughout the entire research process. Completion of this thesis simply would not have been possible without the input and support that they have each provided.

Massive thanks and appreciation also must go to my family. They have each provided unstinting support throughout each of my academic pursuits. They have also been first to celebrate my successes and provide comfort during more difficult periods. An equally big thank you also goes to my partner, Leanne, for the sacrifices she has made to tolerate my academic exploits for the past 12 years.

# Chapter One: Introduction

This chapter will provide an insight into the what, why, and how of this investigation. Each topic discussed throughout this chapter will be revisited in more detail throughout this thesis. The ‘what’ refers to the specific focus and questions under investigation, the principal argument, and parameters of the project. Here, adopted definitions of concepts and terminology fundamental throughout subsequent discussion will also be discussed. The ‘why’ section will build the rationale behind this investigation, particularly focusing on the political and academic context which will serve as a platform for the originality and value of this investigation for relevant agents. Finally, the ‘how’ will offer a brief overview of the adopted theoretical framework, methodology, and research methods, before concluding with a structure of this thesis

## 1.1. What

Perhaps because ‘education is too important to be determined by unfounded opinion, whether of politicians, teachers, researchers or anyone else’, a culture ‘in which evidence is valued over opinion’ (Slavin, 2002; p. 21) is being promoted. Within England, schools and the teachers within have (for some time) been encouraged by policy-makers and some academics (e.g., Malin & Brown, 2020; Goldacre, 2013; Slavin, 2004) to engage with educational research and use the findings to guide their practice. These actions are usually encouraged under the premise that research engagement will enhance teachers’ practice thereby resulting in enhanced student achievement. Within that proposition, there are several assumptions and the current investigation was conducted to create knowledge and evidence about their plausibility and success to-date.

More specifically, this investigation identified: a) whether educational researchers have created a body of knowledge which is consistent, robust, and useful for guiding teachers’ practice, b) the thrust with which schools (and the teachers within) drive to engage with educational research, and the steps they take to do so, c) teachers’ awareness of well-established educational research findings, and d) a relationship between being research-informed and student achievement. It is worth noting at this stage that this investigation is limited to mainstream secondary schools in England and the teachers within those schools.

There are several terms and concepts that are fundamental to discussion throughout this thesis. ‘Research’ is perhaps the most central of those and, although there is some disagreement about its constituents, a starting point is the official (and quite widely accepted) Higher Education Funding Council for England (HEFCE) (2011) definition: ‘a process of investigation leading to new insights, effectively shared’. Their definition is somewhat vague and all-encompassing. Of specific interest to this investigation is academic research (i.e., research which is externally-produced and peer-reviewed) and some discussion will be allocated to distinguishing it from other types of research which teachers and schools may be involved in (or with).

Academic research is usually conducted with the intention of achieving the following HEFCE (2011) objectives: significance, originality, and rigour. Significance is determined by the extent to which it addresses important, non-trivial issues. Originality is achieved when research generates new knowledge and rigour is ascertained by conducting research in a way that is systematic and in accordance with established scientific procedures. Academic research is further unique because prior to publication it is subjected to scrutiny through a peer-review process to (help) ensure that it meets HEFCE (2011) objectives. However, as noted by Cain (2018), debate persists about how best to ensure academic research is high quality because despite the peer-review process, poor-quality research is sometimes published.

Though beyond the scope of this investigation, there are other forms of research which schools and teachers may be involved in (e.g., teacher research). Briefly, academic research and teacher research generally have different objectives. For Cain (2018), the objectives of academic research align with those set out by HEFCE (2011) and, in a nutshell, with the aim of generating knowledge which can theoretically be generalised beyond the sample and setting involved. Usually, the objectives of teacher research are instead placed on improving an aspect of one’s practice. For that reason, teacher research tends to fair unfavourably compared with academic research in terms of significance, originality, and rigor.

Encouragement for teachers to use research to guide their practice is usually referred to as a drive towards ‘research-informed education’ and that is the second key concept throughout this thesis. Research-informed education sits within a broader ambition towards ‘evidence-informed education’ for which the Department for Education (DfE) (2014) is a central driver and, as such, its definition has been adopted: ‘a combination of practitioner expertise and knowledge of the best external research, and evaluation-based evidence’. The interpretation of their definition taken here is that teachers should guide their practice using an interplay of different types of evidence and ‘practitioner expertise’. This interpretation has been created in conjunction with those of Cain (2018) and, Brown and Greaney (2018).

Practitioner expertise is a vague, ambiguous concept which authors use a range of terms to describe (e.g., virtuosity (Biesta, 2012); practical wisdom (Goodfellow, 2003); professional knowledge (Shalem & Slonimsky, 2013)). As this investigation focuses on the role that research can play in guiding teachers’ practice, practitioner expertise will be only touched upon throughout. ‘Best external research’ relates to the role of evidence created through educational research. ‘Evaluation-based evidence’ refers to meta-analyses and research syntheses (e.g., Hattie, 2009; Education Endowment Foundation (EEF) Toolkit, 2020 ) (Brown & Greany, 2018).

To provide research-informed education, it will be argued that schools and the teachers within must engage with educational research (i.e., become ‘research-engaged’). Typically, it is educational research that will be in focus throughout this thesis, however, there will be clearly signposted occasions whereby research from other disciplines (e.g., neuroscience) will be introduced. Incorporating the aforementioned definition of research, ‘educational research’ refers to that which is conducted to improve teaching and school effectiveness (Whitty, 2006). Bassey (1999; p. 39) earlier put forward a similar conceptualisation and argued that educational research should be ‘aimed at informing educational judgements and decisions in order to improve educational action’. This definition has been adopted because it aligns with the current political drive towards improving education through utilisation of educational research.

For Nelson, Mehta, Sharples, and Daveys (2017), educational research engagement can manifest through a range of activities. However, to simplify it for the time being, it can happen by either engaging *in* or *with* educational research. Usually, engaging *in* educational research involves teachers conducting research (e.g., action research). Engaging *with* educational research, which is the focus of the current investigation, involves accessing educational research whether at source (e.g., journal articles) or through less formal means (e.g., social media). Hence, the conception of 'educational research engagement' in this investigation is not prescriptive and encompasses any actions undertaken by schools and teachers with the aim of accessing educational research. The conception adopted here aligns with that used in some similar investigations (e.g., Coldwell et al, 2017) but is more inclusive than that used in others (e.g., Nelson et al, 2017). The implications of accepting less formal methods of research engagement will be discussed later.

The final key concept to be defined is referred to as teachers' 'awareness' of educational research findings. The definition for this has been taken, but narrowed, from Nelson et al (2017) and will be measured by teachers' ability to objectively identify teaching principles that have been established through robust educational research to be consistently effective in raising student achievement.

'Teachers' represents all fully-qualified (i.e., PGCE or equivalent) teachers within schools including those in positions of leadership. 'Senior management team' (or 'SMT') will be used when those in positions of school leadership are in focus, usually limited to headteacher, assistant headteacher(s), and deputy headteacher(s). Those occupying positions in schools but not fully qualified teachers were excluded from this investigation.

### 1.2. Why

The rationale for this investigation stems from increasing pressure from policy-makers in England as well as some academics: a) to create and make available to teachers a robust body of educational research (Hargreaves, 1996), b) on schools and teachers to draw upon knowledge created through educational research and use it to guide their practice (e.g., Goldacre, 2013), and c) to understand the relationship between research engagement, teachers' pedagogical knowledge, and student achievement (Levin, Cooper, Arjomand, & Thompson, 2011; Brown & Greaney, 2018; Cain, 2018).

For Biesta (2007, 2010), policy-makers appears intent on operationalising the following approach: commission educational research to identify 'what works' in the classroom, transfer that knowledge to schools where it is to be read, understood, and implemented by teachers into their practice, teachers' practice will subsequently be enhanced and students will achieve better as a result. Consequently, educational researchers are being confronted by policy-makers with questions about the usefulness of their work for directing teaching practice. Problematically, policy-makers are attempting to operationalise this approach despite little evidence to support its plausibility or effectiveness. Although there is some evidence of a relationship between teachers' awareness of research findings and their practice (e.g., Piasta et al, 2020), Cain (2018; p. 21) and Coldwell et al (2017) describe the available evidence of a relationship between research-informed education and student achievement as 'thin' and based on little more than an assumption.

For Tripney, Kenny, and Gough (2014), the ambition for research-informed education is present in much of the developed world but the thrust seen in England is largely unparalleled by other European countries. Evidence of this thrust is observable by the wealth of mechanisms introduced by recent governments to: a) increase the production of educational research relevant for guiding teachers' practice (e.g., What Works Centres), b) distribute educational research more widely (e.g., 'open access' policy), and c) enhance teachers' ability to intellectually access educational research (e.g., ResearchED). The effectiveness of those mechanisms in increasing teachers' use of research-based evidence to guide their practice is unclear. Davies (1999) earlier argued that teachers' practice has historically been informed by 'conventional wisdom and folklore' (p. 108). Van Schaik, Volman, Admiraal, and Schenke (2018) recently reported that little has changed - stating that 'teachers' expertise is mostly based on insights acquired in their own practice, and not on knowledge sourced through educational research' (p. 51).

Most commentators point recent political movements towards developing education as a research-informed practice back to Hargreaves' (1996) lecture at the annual Teacher Training Agency (TTA) conference. Hargreaves (1996) was particularly critical of educational researchers and highlighted a disparity between the medical practice which he argued was driven by evidence against teaching practice which was not. Immediately following this Introduction, Chapter Two will be dedicated to detailing the political context in which the current investigation was conducted.

Within academia, the idea that educational research should be relevant to, and beneficial for teachers' practice is not novel. Biesta (2007) traces it back to the end of the 18$^{th}$ century but commentators more commonly point to the work of Dewey (1929) as a starting point of such discussions. Nonetheless, the extent to which educational research can (and should) be practically relevant to teaching practice remains contested largely between two 'camps'. In one camp are those (e.g., Goldacre, 2013; Slavin, 2002) arguing that the primary goal of educational research should be to provide teachers with strategies which they can import into their practice, and there is reason to believe that policy-makers subscribe to this perspective (e.g., *The Importance of Teaching* (DfE, 2010)). In the other camp are academics (e.g., Hammersley, 2005) who maintain that educational research cannot be at the forefront of guiding teaching practice. Proponents of this perspective typically argue that the primary goal of educational research should be to develop knowledge of education as a discipline in its own right. For Biesta (2012; p. 583), this may include 'providing different interpretations of educational reality' which teachers can engage with and use to help make sense of their professional situations thereby potentially benefitting teaching practice though much less directly.

The relevant literature highlights several recurring obstacles that education within England faces in becoming a research-informed practice. Despite substantial investment from recent governments in mechanisms to make the transfer of knowledge between its point of conception in academic educational research to teachers' implementation in the classroom smoother (see Chapter Two), research-informed education remains difficult to achieve. To provide some explanations, Hammersley (2005) reports that criticisms are generally aimed at research users (i.e., teachers, policy-makers) and more typically at educational researchers.

Research users are criticised for: a) resistance to research-based teaching strategies, b) failing to accurately interpret educational research findings, and c) lacking motivation to engage with educational research as a means to improve their practice. Educational researchers have been accused by academics (e.g., Hargreaves, 1996) and teachers (e.g., Cain, 2016a) of failing to: a) conduct research addressing concerns of research users, b) develop a consistent and coherent evidence base, c) conduct methodologically robust research, and d) disseminate research using accessible language through accessible platforms.

This investigation's original contribution to knowledge lies in the provision of empirical evidence on the following fronts, each of which current research has largely neglected:

- Follow and examine research-based knowledge from its conception to point of impact in raising achievement
- Identify well-established educational research findings in the form of teaching principles
- Explore the relationship between the extent to which schools engage with educational research and teachers' awareness of well-established educational research findings.
- Investigate the relationship between engagement with educational research and student GCSE scores.

In meeting those objectives, this investigation will benefit teachers, educational researchers, and policy-makers. For teachers, the value may be in the identified well-established, research-based teaching principles which, as it will be argued, consistently raise student achievement when implemented in the classroom. This investigation also contributes towards developing a theoretical understanding of the relationship between research engagement, teachers' pedagogical knowledge, and student achievement thereby benefiting educational researchers. Of value to policy-makers, this investigation provides the best available evidence about the effectiveness of research-informed education drivers in raising teachers' awareness of educational research findings and subsequently student achievement.

### 1.3. How

In line with some similar literature (e.g., Nelson et al, 2017), this investigation adopted a pragmatic research philosophy. Essentially, that means the adopted research methodology and subsequent methods were determined by the extent to which they could effectively tackle the respective research question (RQ). Consequently, a multimethod research strategy was developed which consisted of: a) a literature review to identify well-established educational research findings, b) a survey administered to the person(s) within each participating school to identify the thrust of their engagement with educational research (hereon referred to as the 'School Survey'), c) a survey distributed to teachers to identify their awareness of well-established educational research findings (hereon referred to as the 'teacher-survey'), and d) correlational analysis exploring a relationship between the findings from both surveys and school GCSE performance.

# Chapter Two: Political Context

This chapter will illustrate the thrust with which policy-makers in England are driving towards developing education as a research-informed practice. Discussion will begin by building on the previous chapter and further contextualising the concept of research-informed education under the broader umbrella of evidence-based practice. Moving forward, the promises of research-informed education will be deliberated, and the reader will be navigated through changes in policy throughout recent history which have culminated in the current political stance. This chapter will conclude by discussing how the highlighted political ambition has manifested in current government policy and corresponding initiatives and mechanisms created to promote research-informed education.

## 2.1. Research-Informed Practice Within Evidence-Based Practice

Tripney et al (2014) describe 'evidence-based practice' as an approach to improving outcomes for learners by using the 'best evidence' available to shape policy and practice. For Wrigley (2018; p. 359), 'the need for professionals to draw on evidence rather than political authority or custom and practice is not difficult to argue'. Proponents of evidence-based approaches to practice (e.g., Tripney et al, 2014; Whitty, 2013) attribute improved outcomes within medicine, social work, agriculture, and physiotherapy to the adoption of this approach. A fundamental principle of evidence-based practice is that practitioners (e.g., teachers) will make better decisions if they are aware of the available evidence supporting and contradicting 'what works'.

In contrast to an evidence-based approach to practice, Maggs and White (1982; p. 131) state that, historically 'few professionals have been more steeped in mythology and less open to empirical findings than teachers'. For Smith, Daunic, and Taylor (2007; p. 121), teachers' practice has instead been guided by 'anecdotal evidence and a *collective sense of expert opinion*' neither of which they argue 'provide educators with precise or enough information to determine which educational practices are truly effective, for whom, and under what circumstances'. Notably, it is unclear which agents Smith et al (2007) are referring to in the italicised portion of the previous quote. Reasonably, educational researchers, highly-experienced teachers, and/or policy-makers could each be perceived as being ‘expert’.

Hempenstall (2006) reinforces the concerns of Smith et al (2007) and Maggs and White (1982), submitting that although education has a history of adopting new ideas to improve learning it has often been without sufficient supporting evidence. According to Sebba (2004), this unsystematic approach could potentially be to blame for a long-term lack of improvement in the quality of education. For Lysenko et al (2014), calls for education to adopt an evidence-based approach are largely in response to such concerns. Consequently, increasing attention is being paid internationally to developing ways in which evidence can be used to shape educational policy and practice, and ultimately improve student achievement (Cain, 2016a; Biesta, 2007, 2010; Hammersley, 2005). For Katsipataki and Higgins (2017), this perspective is commonly labelled as a drive towards evidence-based education.

A fundamental issue in developing evidence-based education is uncertainty about what constitutes evidence. The Oxford Dictionary (2014) defines evidence as ‘the available body of facts or information indicating whether a belief or proposition is true or valid’. Therefore, information can only be considered ‘evidence’ in light of a belief or proposition. Relating this definition to teaching practice, teachers could draw on a wide variety of information in a bid to enhance practice. For example, data relating to student prior achievement would serve as a form of evidence if associated with, or attributed to, a proposition. Research can provide one form of evidence which teachers may draw upon in guiding their practice and, to reiterate, it is the role of research which is in focus here.

Broadly speaking, two perspectives exist under the umbrella of evidence-based practice with diverging perspectives about the extent to which teachers’ practice should be influenced by evidence. Relating those perspectives to the use of educational research, the first perspective is commonly referred to as research-based education and proposes that teaching practice should be *based* on research evidence. The second perspective, research-informed education, proposes that teaching practice should be *informed* by research evidence. The definition of the second perspective adopted here was taken from DfE (2014) and provided in section 1.1. It has also been adopted in much of the recent relevant literature (e.g., Coldwell et al, 2017; Malin & Brown, 2020). Essentially, both perspectives endeavour to increase the regularity with which educational research findings are transmitted and incorporated into education policy and practice thereby enabling teachers to make better decisions, provide more effective practise and, ultimately, improve student achievement.

Research-based education is characterised by Everton, Galton, and Pell (2002) as use of knowledge created through research to 'direct' teachers' practice. For proponents of this approach, an idealistic example would be teachers endeavouring to raise student achievement by indiscriminately transferring and implementing interventions which have been evidenced to be effective through robust educational research. Van Schaik et al (2018) highlight the following flaws in the research-based education perspective: firstly, it inaccurately implies that research-based evidence can be transmitted directly into educational policy and practice. Secondly, over emphasis on the role of research-based evidence can diminish the influence of experience and 'tacit knowledge' that teachers possess. Sternberg (2001; p.1) defines tacit knowledge as 'knowledge which individuals use to perform effectively but which they may find hard to articulate'. Quite differently from knowledge acquired through research, tacit knowledge is informal and is an aspect of 'practical wisdom' that influences teachers' practice (Hodkinson & Smith, 2004). Teachers cite concern that research-based knowledge is a 'poor substitute for actual experience' (Beycioglu, Ozer, and Ugurlu, 2010; p. 1088) and researchers share concern that excessive value on research-based knowledge may undermine knowledge acquired through teachers' professional experience (e.g., tacit knowledge, vicarious experience, interpersonal skills) (Brown & Zhang, 2016; Biesta, 2007; 2010).

Following acknowledgement of fundamental limitations to research-based education, a more nuanced perspective about the way research can be used to develop teachers' practice and raise student achievement has emerged – research-informed education. For Coldwell et al (2017), use of the term 'informed' rather than 'based', within the DfE (2014) directive (provided in section 1.1) 'emphasises that teaching, is a complex, situated professional practice, drawing on a range of evidence and professional judgment, rather than being based on a particular form of evidence' (p. 5). Coldwell et al's (2017) view somewhat echoes Brown and Zhang's (2016) earlier suggestion that the term 'combination' represents concessions that: a) teachers' practice cannot be based solely on research evidence, and b) teachers should use educational research in conjunction with other forms of evidence (e.g., student achievement data).

Advocates of research-informed education (e.g., Gore & Gitlin, 2004; Tripney et al, 2014; McMillan & Schumacher, 2014) argue that whilst research can direct teachers towards a range of potential interventions or resolutions, it often cannot be prescriptive. A possible exception to that rule, highlighted by the DfE (2016), is the use of systematic synthetic phonics to raise literacy levels amongst primary school students. They identify Johnston and Watson's (2005) longitudinal research as 'reinforcing decades of research showing positive effects' (p. 41) of the use of synthetic phonics to teach early reading. Johnston and Watson (2005) recruited approximately 300 students in P1 (the equivalent of Reception class in England) from 13 primary schools in Scotland and divided them into three groups. The experimental group learnt using the synthetic phonics method and two control groups learnt using standard analytic phonics methods. After the 16-week intervention, the experimental group's word reading, spelling, and reading comprehension were 7-9 months ahead of the control groups and their chronological age. More strikingly, participants were followed up at P7 (the equivalent of Year 7 in England) were the experimental group's word reading had extended to being 40 months ahead of their chronological age, spelling extended to 21 months ahead, and reading comprehension was 3.5 months ahead.

DfE (2016) argue that despite evidence such as that provided above, synthetic phonics has until recently been disregarded by many schools and local authorities. Seemingly taking a step towards research-based education, the DfE (2016) initiated synthetic phonics reading schemes nationwide. However, the waters became muddied by Torgeson, Brooks, Gascoine, and Higgins' (2018) synthesis of 12 meta-analyses covering 452 investigations which reported 'little evidence' in favour of any single method of teaching phonics. Notably, Torgeson et al's (2018) synthesis failed to identify under which conditions larger effect sizes were obtained and the extent to which they evaluate the methodological quality of included studies is unclear. Essentially, the problem here is that government can (often mistakenly) base policy on seemingly unambiguous research findings. However, the complex nature of research means that findings should be considered with an understanding of the subjective decisions and interpretations which take place throughout the research process (see section 6.3 for examples). As such, research findings should be used only to inform policy and practice rather than dictate it.

## 2.2. Promises of Research-Informed Education

Cain (2018) illustrates that the prospect of using research-based evidence to inform teaching practice is said to be ‘better than its alternatives’ (p. 10). Estelle Morris, former Secretary of State for Education and chair for the *Institute of Effective Education,* provides an example of an alternative against which research-informed education is often positioned arguing that ‘teaching needs less ideology and more evidence’ (Morris, 2014). For Wrigley (2018, p. 359), ‘the need for teachers to draw on evidence rather than [....] custom and practice is not difficult to argue’ and is ideologically reinforced in ‘the modern era (where) numerical data are presented as objective, unmediated, unbiased and scientific carriers of facts’.

Proponents of research-informed education (e.g., Tripney et al, 2014) stipulate that the production and consumption of educational research-based knowledge can transform educational policy and teaching practice by ‘the kind of progressive improvement that most successful parts of our economy and society embarked upon a century ago’ (Slavin, 2002; p. 20). For Tripney et al (2014), knowledge created through educational research could form a catalyst for improved educational policy and teaching practice by conclusively establishing the effectiveness of any given intervention or strategy in raising student achievement.

Many academics have commented on the usefulness of comparing education to medicine, but few acknowledge obstacles medicine faced in becoming evidence-based. Wrigley (2018) argues that evidence use in medicine is complex, ‘demands individualised evidence in a format that clinicians and patients can understand’ and ‘is characterised by expert judgement rather than mechanical rule following' (p. 361). Greenhalgh, Howick, and Maskrey (2014) criticise medical professionals for over-stating the value of 'evidence' and lacking an ability to apply accumulated practical experience and ethical judgement.

For McMillan and Schumacher (2014), potential beneficiaries of research-informed education spread beyond students to include teachers, policy-makers, and stakeholders (e.g., student parents, developers of curricula). Though important to acknowledge the many potential beneficiaries of research-informed education, predominantly perceived benefits for teachers and students are in scope throughout this investigation. Nisbet (2005) argues that research-informed education could provide teachers with an opportunity to validate their practice using research-based knowledge and that is conceivably beneficial to teachers through: a) reassuring those already using research-informed approaches about their effectiveness, and/or b) facilitating the opportunity for those not using research-informed approaches to begin incorporating those that are. Winch, Oancea, and Orchard (2018; p. 203) largely reinforces the prior suggestion, suggesting that research is 'uniquely well-placed to provide a valid and insightful account of educational reality' which 'provides a usually reliable warrant for professional action'.

McMillan and Schumacher (2014) further promote the impact that research could have in empowering teachers and transforming school cultures from one whereby teaching practice is guided by policy-makers' preference to one led by objective robust evidence. For Hargreaves (1996), this transformation has not been historically feasible because the foundation disciplines of education (i.e., philosophy, psychology, sociology) have failed to provide teachers with a consistent and coherent body of research-based evidence. McMillan and Schumacher (2014) reinforce that criticism and suggest that embracing research-informed education may initiate the development of a coherent body of methodologically robust educational research. Several initiatives have been created to take steps in that direction and are discussed in section 2.4.

Possibly reinforcing the DfE's (2016) stance on the use of systematic synthetic phonics, Seidenberg (2017) opposes Hargreaves' (1996) criticism highlighting that over the previous 30 years research in cognitive science, neurobiology, and linguistics has consistently demonstrated key principles about the teaching of reading. Despite replicated findings, Seidenberg (2017) argues that some teachers continue using alternative methods without a strong and coherent evidence-base for several reasons. The first is an important concept throughout this thesis; the suggestion that 'educators are deeply immersed in their own worldview and well defended against incursions from outside' (p. 35) including educational research findings. That defence is said to be attributable to 'education as a discipline placing higher value on observation and hands-on experience' (p. 36). Seidenberg (2017) progresses to acknowledge the limitations of initial teacher training (ITT) programmes which fail to 'expose teachers to modern research' and instead focus on 'the views of a few authorities' (p. 36) of whom Lev Vygotsky is cited.

Of the research-informed education promises commonly cited, the most relevant for this investigation is the suggestion that its realisation can result in more effective teaching practice and subsequently improved student achievement. There is an increasing quantity of empirical research which has been conducted to identify a relationship between the extent to which teachers engage with educational research and the effectiveness of their practice and student achievement. An introduction to the relevant literature will be provided momentarily but will be revisited in more detail (e.g., Rose et al, 2017) in section 3.7. On behalf of the Centre for the Use of Research and Evidence in Education (CUREE), Bell et al (2010) conducted a systematic review across teachers from primary and secondary schools to relationships between their educational research engagement, effectiveness of practice and subsequent impact on learners.

Bell et al (2010; para. 6) report 'strong evidence' across the 25 studies included within their review of 'links between teachers' research engagement [...] and significant changes in practice with a positive impact on student outcomes'. The 25 studies included were sourced from a two-stage literature search with various criteria included in both stages. Unusually, most (14) studies meeting the instated criteria were conducted in the UK which enhances the extension of subsequent findings to the contexts in discussion throughout this investigation.

More commonly, most included studies entailed a relatively small number of teachers (i.e., 2-5) with more variation in the number of participating students.

In terms of a relationship between research engagement and student outcomes, 14 of the included studies revealed improved student knowledge outcomes, and the robustness of the measures used to identify those outcomes is unclear. More commonly, the included studies used outcome measures of student behaviour, attitudes, and motivation. Six of the included investigations identified a positive relationship between research engagement and teachers' content knowledge, and a further 10 investigations revealed that teachers reported 'enhanced professional growth' (e.g., confidence, motivation) following increased engagement with educational research.

### 2.3. History of Research-Informed Education

This section will briefly tour political events which have attributed to the current political ideology for research-informed education. As highlighted by Cain (2016a), the idea of using research-based evidence to inform teachers was raised almost one century ago in USA by Dewey (1929). In England, the National Foundation for Education Research (NFER) (2018) was created in 1947 to 'equip practitioners with the most innovative thinking and practical research to underpin the drive towards excellence in education'.

However, as mentioned in section 1.2, Hargreaves (1996) is usually highlighted as instigating the current political drive in his protest against: 'second-rate educational research which does not make a serious contribution to fundamental theory or knowledge; which is irrelevant to practice; which is uncoordinated with any preceding or follow-up research; and which clutters up academic journals that virtually nobody reads' (p. 5). He also prompted comparisons between education and medicine and proposed that education should follow medicine to become an evidence-based practice where practitioners' actions are routinely guided by analysis of the evidence available. These demands were made on the premise that they would provide students with the greatest opportunity to achieve. He also argued for a co-ordinated approach in which 'practitioners and policy-makers take an active role in shaping the direction of educational research' (p. 6) proposedly achievable by:

- increasing teachers' involvement in educational research production and consumption
- increasing educational researchers' accountability to teachers
- disseminating educational research across research users more effectively.

Following Hargreaves' (1996) lecture, the Office for Standards in Education (Ofsted) and the Ministry of Education commissioned inquiries into the practical usefulness and methodological quality of educational research. The Tooley Report (Tooley & Darby, 1998), commissioned by Ofsted, concluded that the validity of much peer-reviewed educational research was compromised due to methodological flaws. The Hillage report (Hillage, Pearson, Anderson, & Tamkin, 1998), conducted for the Ministry of Education, cited concern about a lack of generalisability of educational research largely attributed to small sample sizes. Further criticism was directed towards educational research because of its inaccessible language and platform. Both inquiries concluded that educational research more relevant to research users would enable greater utilisation of respective findings, and therefore further assist in guiding educational policy and teachers' practice.

Following those reports, the government implemented interventions to reform educational research and enhance its usefulness. The Economic and Social Research Council (ESRC) was given additional accountability for the quality of educational research and is now responsible for dispersing funding to produce it. In a speech to the ESRC, then Secretary of State for Education, David Blunkett, offered an insight into the educational research desired: "We welcome studies which combine large scale, quantitative information on effect sizes which will allow us to generalise" (Blunkett, 2000).

The Evidence for Policy and Practice Information and Coordination Centre (EPPI-Centre) within the Institute of Education was also created to assist in regulating the quality of educational research by 'developing methods for systematic reviewing and synthesis of research evidence, developing methods for the study of the use of research' (eppi.ioe.ac.uk/aboutus), and providing support through methodological tools and guidelines, quality assurance and a free web-based library of finished reviews (Oakley, Gough, Oliver, & Thomas, 2005). In line with the drive towards research-informed education, research evidence is communicated to teachers with the intention that they will incorporate it into their practice thereby improving it and subsequently student achievement. The output of education-related systematic reviews from the EPPI-Centre appears to have dwindled, only one of 25 published reviews since 2016 are within the field.

More recently, Goldacre (2013) restated the necessity for education to make better use of research-based evidence by reiterating many criticisms lodged previously by Hargraves (1996) and further advocating the suggestion that education should emulate medicine. He argued that in becoming research-informed, teachers' professionalism will be enhanced serving to empower them in legitimately defying figures of authority (e.g., governments, SMT) by using 'informed judgement'.

Debate about the usefulness of research-informed education continues within academia and the implications of that discourse are observable in policy. DfE (2016) detail plans for *Educational Excellence Everywhere* by setting out how to strengthen ITT through use of 'a greater understanding of the most up-to date research' and ensuring 'discredited ideas unsupported by firm evidence are not promoted to new teachers' (p. 12). They propose that the cited steps will contribute towards education developing 'a hallmark of a mature profession; a body of evidence which sets out what works and what doesn't' (p. 41). Interestingly, Goldacre (2013) is the most common reference throughout that White Paper which may indicate government endorsement for his perspectives on developing education as a research-informed practice.

The DfE (2016) also state that teachers should exercise autonomy in shaping their practice by utilising the 'best evidence available about what really works' (p. 41). For Brown and Greany (2018), promoting autonomy signals a shift in policy from (predominantly) top-down approaches to school improvement under New Labour (1997-2010) to the recent Coalition and current Conservative government's focus ‘on schools themselves sourcing and sharing effective practice to facilitate change’ (p. 115). Evidence of a shift towards a self-improving school system can be seen in The Importance of Teaching (DfE, 2010) which justifies the policy change on the premise that ‘the attempt to secure automatic compliance with central government initiatives reduces the capacity of the school system to improve itself’ (p. 13). Greany (2014) characterises the self-improving school system as one in which government support and intervention is reduced, and teachers and schools are both increasingly: a) responsible for their own improvement (in which research could play a major role), and b) required to learn from each other develop through inter-school collaborations.

As pointed out by Brown and Greany (2018), the discussed DfE (2016) perspective represents current policy which ostensibly encourages schools to seek help independently and through inter-school collaboration by accessing and using research-based evidence rather than taking direction from local authorities and/or central government. The provision of greater school autonomy can be seen in the increasing number of academies (i.e., institutions managed independently but funded directly by central government) which risen to 5,500 by 2016 (i.e., almost one-in-four schools in England). Increased autonomy facilitates greater freedom to appoint staff according to local needs and that includes adjusting pay scales and employing unqualified teachers, as well as greater scope in determining their own direction to becoming research-informed in topics of importance in that context. Brown and Greany (2017, 2018), and Godfrey and Brown (2018) report some concern about the increasing number of academies, arguing that it could create a two-tier system in which some schools have greater access to networks that facilitate the sharing of knowledge (e.g., multi-academy trusts) than others.

In addition to the rapid expansion of multi-academy trusts, teaching schools were also created following publication of The Importance of Teaching (DfE, 2010). The National College for Teaching and School Leadership (NCTSL) (2014) promote the role of teaching schools in providing support for other schools by leading cross-school CPD and research and development activity

Alongside the high autonomy that schools are being offered and serving to contravene explicit goals of collaboration, schools are being held to ‘a tight accountability framework as a means of ensuring consistency and driving improvement' (Brown & Greany, 2017; p. 7). Evidence of the high accountability system include publication of individual school performance in national exams and grading of individual schools' quality following regular inspections. Schools underperforming on either count are subject to government intervention. Whilst accountability systems ostensibly may be seen to provide clear constituents of 'success' to which schools can drive towards, there is a risk that schools may decline into 'unhealthy performativity regimes flattening the very freedom, autonomy, and innovative ethos that governments want to encourage' (Brown & Greany, 2017; p. 10). Furthermore, as alluded to earlier and noted by Godfrey (2016), the logic that inter-school collaboration will prosper in an environment in which schools are competing seems optimistic.

### 2.4. Policy Drivers Promoting Research-Informed Education

Brown and Greany (2018) contend that little evidence exists about how to most effectively connect research-based evidence and teachers' practice. Additionally, as will be argued in section 3.5, the evidence-base created from educational research is growing but not necessarily resulting in teachers being more aware of research findings or placing greater value on them. Despite those incongruities, government drive for research-informed education has manifested in the creation of several initiatives across England designed to: a) promote the production of 'useful' educational research, b) make educational research more accessible for research users, and c) narrow the perceived gap between research, policy, and practice. Collectively, the purpose of the mechanisms to be discussed is to encourage and facilitate research users' engagement with, and utilisation of, educational research to improve their practice.

Tripney et al (2014) group the relevant mechanisms into those which 'push', 'pull' and 'mediate' research utilisation. 'Push' mechanisms are created to encourage the commission of research with 'real-world' relevance for research users. For example, educational What Works Centres have been government-funded with £135million over a 10-year period (Cabinet Office, 2013) to conduct and communicate well-constructed research to research users about the effectiveness of interventions in improving teaching practice and subsequently student achievement. The EEF (2016) is a branch of the What Works network tasked with conducting, synthesising, and communicating methodologically sound research to identify cost-efficient teaching interventions that effectively raise student achievement. A second mechanism, discussed by Cain (2016a), is the Research Excellence Framework (REF) created to measure the impact of UK universities' research on, 'the economy, society, culture, public policy or services … beyond academia' (HEFCE, 2011; p. 48) which then determines subsequent university funding. A third 'push' mechanism is the Teaching and Learning Research Programme granted over £40 million from the ESRC to undertake research and facilitate 'a strengthened approach to strategic planning' (Brown & Greany, 2018; p. 119).

Cain (2016a) describes 'Pull' mechanisms, such as the Carter Review (2015), as those created to encourage teachers' engagement with education research. As highlighted by Hempenstall (2006) and Goldacre (2013), this goal is achievable only if teachers have the intellectual and physical tools necessary to identify, understand, utilise, and evaluate educational research. To assess the extent to which ITT programs are providing trainee teachers with the ability 'to access [&} assess the robustness of educational research [and] understand and apply the findings from educational research' (DfE, 2014), a survey is now administered to all newly qualified teachers.

An additional pulling mechanism, created to assist teachers in making use of educational research is ResearchED, described by Education Development Trust (EDT) (2016; p. 9) as a 'teacher-led organisation aimed at improving research literacy in educational communities [… and…] getting the best research where it is needed most and providing a platform for educators'. ResearchED (2016) aim to achieve this by: a) creating forums to encourage teacher collaboration, and b) disseminating educational research through conferences and 'accessible subscription-based magazines'.

'Research lead' roles within some schools have also been created which, according to Riggall and Singer (2016; p. 9), are 'paying dividends - particularly in the area of improved whole-school professional development'. That analysis is based on surveys conducted across 55 research leads, seven of whom were followed up for interviews and reported the following responsibilities:

- Access and disseminate research findings within their setting
- Assist teachers in conducting action research
- Build and maintain school collaboration programs
- Collaborate with universities

As highlighted by Rigall and Singer (2016), responsibilities and objectives of the research lead role are evolving because it is a relatively new concept. Notably, only those who 'registered interest in a ResearchED event' participated hence respondents may have been an atypical representation of the target population.

'Mediating' mechanisms promote the transition of knowledge created by educational research to research users. For example, the open access policy provides teachers with a free facility to access publicly funded educational research (Research Councils, 2013). A second example is the EDT (2016) charity which 'works collaboratively with national and local governments, schools and other partners to design and deliver sustainable solutions to improve education'.

Gough et al (2011) argue that a revived drive towards reaffirming the connections between educational research, policy, and practice can also be seen across North America and northern Europe. For example, in 2003 the Netherlands' educational government advisory body published a report citing concern about the limited practical use of educational research findings (Vanderlinde & Van Braak, 2010). In the USA, the Coalition for Evidence-Based Policy (2002) highlighted similar concerns, adding that educational research lacks methodological quality.

Tripney et al (2014) provide further evidence of increasing international enthusiasm towards building a relationship between educational research, policy, and practice. Their aim was to identify the number of 'activities' implemented 'to improve the use of research in different parts of the production-to-use system' (p. 64). In total, 269 activities were identified from 30 of 32 countries investigated in Europe; 181 were described as 'push' mechanisms, 27 as 'mediating' mechanisms, and the remainder as 'pull' mechanisms. The leading European country in terms of identified number of mechanisms was the UK with 74, followed by France with 29.

Evidencing the magnitude of recent and current government thrust towards research-informed education, over 25% of the mechanisms identified were conceived in the UK (a breakdown within the UK is not provided) and 'most of the examples we identified were set up in the past twenty years (primarily within the past decade)' (p.65). The latter observation has since been reinforced by Brown and Greany (2018).

Tripney et al's (2014) investigation provides a basic map of activity across Europe, but the approach taken to identify relevant activities could have been more systematic. They initially distributed a survey in English only (possibly impacting response rate) across a 'nonrepresentative, nonexhaustive' (p. 59) sample, and followed it up with a literature review to identify further activities. They also admit difficulty 'in identifying suitable survey participants' (p. 65) because responsibility for educational provision across European countries can be at a regional (rather than national) level.

Despite implementing interventions such as those discussed, Cherney et al (2012), Brown, Daly, and Liou (2016), and Ion, Marin, and Proteasa (2019) maintain that educational research continues to rarely impact on policy or practice and often fails to meet the needs of research users. Brown and Greany (2018; p. 119) reinforce that, stating that the impact of government investment in England has been 'mixed' and arguing that there is little evidence of schools being better able to make use of research-based evidence to inform teaching practice. Lacking consistency in effectiveness is partially ascribed to New Labour's over-reliance on push mechanisms, which would align with their top-down approach to school improvement.

### 2.5. Summary

Government narrative is quite clear in insisting that teachers make better use of available evidence to guide their practice in the hope that their practice will improve and students will subsequently achieve better. The type of evidence under focus in this investigation is that created through educational research. Perhaps indicating acceptance of well-documented limitations of a research-based approach to education, several government communications suggest that they are instead pursuing research-informed education. Essentially, the concept of research-informed education accepts that teaching practice is complex, and research-based evidence forms one 'input' of many that teachers should make use of to practise effectively.

Developing research-informed education will proposedly benefit teachers, policy-makers, and stakeholders, but development of research-informed education necessitates resolving repeated concerns surrounding a lack of rigour, coherence, and relevance to teachers of educational research. Though of questionable success, multiple initiatives have been created and received significant financial support to bring together the practice of researchers and research users by: a) promoting methodologically sound educational research that tells us 'what works' in raising student achievement, and b) encouraging research users' engagement by ensuring that research is distributed on a platform, and in a language, that is accessible.

# Chapter Three: Literature review

## 3.1. Chapter Structure

As illustrated within the preceding chapters, there are a selection of academics and a mainstream ambition amongst policy-makers that education should drive to become a research-informed practice. Within that thrust, there are (broadly) the following assumptions:

1. Educational research generates useful knowledge for teachers
2. Schools facilitate educational research engagement
3. Teachers engage with educational research
4. Educational research engagement enhances teachers' knowledge
5. Teachers use educational research to guide practice
6. Being research-informed positively influences student achievement

This chapter will explore each of those assumptions, providing a critical overview of philosophical and empirical literature most closely related to each. The chapter will conclude with a logic model (Figure 3.1) which illustrates the stated conceptual path and depicts the relationship between each assumption and the formulated RQs. Essentially, the model provides a simplified account of the theoretical path from the conception of research-based knowledge in educational research through to its point of impact in raising student achievement.

## 3.2 Educational Research Generates Useful Knowledge for Teachers

Within Chapter One, two prominent and distinct perspectives (or 'camps' as they were termed) about the role and purpose of educational research were introduced. This section will begin by further unpicking those perspectives and discussing their implications on the types of research being driven and the usefulness of knowledge subsequently created for teachers' practice. Discussion will progress to explore obstacles faced by educational researchers in creating knowledge useful for teachers before concluding with some proposed steps which may enhance the usefulness of research-based knowledge for teachers.

To reiterate, there are broadly two perspectives on the appropriate goal of educational research. The first perspective, commonly labelled as 'research for education' or 'research on education' (Biesta, 2007), broadly aligns with governmental agenda and promotes educational research as a tool to improve education largely by determining 'what works' and providing useful knowledge for teachers to use to enhance their practice (e.g., Hargreaves, 1996; Goldacre, 2013; Slavin, 2004). Ion and Iucu (2014; p. 334) illustrate this perspective by arguing for 'educational research that is carried out with the explicit intention of improving educational practice or policy'. Fundamentally for this perspective, knowledge created through educational research must be usable in an efficient and effective way by teachers as a tool to improve their practice and subsequently enhance student achievement. To realise this perspective, researchers must 'have a practitioner learning perspective in view as they write' (Cordingley, 2008; p. 37). Some authors (e.g., Biesta, 2007) highlight concern that this perspective assumes an overly-simplistic, linear relationship between educational research and teaching practice.

The second perspective conceptualises educational researchers as public or critical intellectuals whose accountability is determined not by immediate impact on policy or teaching practice but by the generation of theory that can contribute to disciplinary knowledge (Oancea, 2005). Hammersley (2005) subscribes to this perspective and posits that educational research can still contribute to policy-makers' decision-making and teachers' practice but in a less-direct way through 'informative' rather than 'educative' means. Here, the role of educational research is to develop theoretical conceptions and provide supporting evidence, but it is then for teachers to use that knowledge only to 'inform' their decision-making. For Leindhart (1990; p. 18), theory-generation is an important purpose of educational research because it can act as 'an efficient, universal, cohesive truth filter for disorganized, practical experience'. In other words, theory generation facilitates: a) potential application across unique situations, and b) a framework for predicting and handling situations not yet encountered without bias.

This dichotomy has implications for the beneficiaries of educational research though there remains disagreement as to who they are. Vanderlinde and Van Braak (2010) stipulate that the intended beneficiaries must be identified because they will influence the questions asked of educational research and the demands placed upon it. For Ion and Iucu (2014), the immediate beneficiaries of education research should be teachers and the role of educational research should be to provide knowledge that is useful to them. In contrast, adopting Hammersley's (2005) perspective would make the research community immediate beneficiaries of educational research. For teachers, Hammersley's (2005) perspective would be problematic for teachers because subsequently created knowledge may be increasingly useless or 'irrelevant' (Hargreaves, 1996). Continuing without a consensus about the purpose of educational research and clearly defined beneficiaries is equally problematic. For teachers, it may result in researchers pursuing different channels of inquiry thereby increasing the likelihood that criticisms for failing to provide teachers with a coherent knowledge-base would be lodged.

Most proponents of the research for education perspective subscribe to the prospect of research-informed education (e.g., Hargreaves, 1996; Goldacre, 2013; Slavin, 2002, 2004) and promote the idea of mimicking the path of medicine (see section 2.2). However, raising questions about the achievability of the research for education perspective, there are differences in research goals between the two fields. Greenhalgh and Worrall (1997) argue that most medical research is carried out with the goal of improving patient health outcomes whereas within education there is greater diversity in research goals (e.g., enhancing student motivation, social justice).

Davies (1999; p. 112), an advocate of research for education, argues that 'medicine [...] face very similar, if not identical problems of complexity, context-specificity, measurement, and causation to education'. However, most (e.g., Hammersley, 2005; Oancea, 2005; Allen, 2013; p. 126) are more nuanced about the relationship between the two fields and admit that whilst they share some similarities, 'the social context in which a student learns shapes outcomes far more than it does the response of a body to a new drug'. Context-specific factors (e.g., student-teacher relationships) add a complicating dimension to the ideology of research-based knowledge being immediately and universally useful for teachers. For example, Hanley, Cambers, and Haslam (2016) note that while particular research methods (e.g., randomised controls trials (RCTs)) may inform us 'what worked' for a particular group and under particular circumstances, attempts to directly transfer those findings to other contexts may be futile because their external validity declines as replication attempts are made in different settings and across different time frames. For Vanderlinde and Van Braak (2010), the two conflicting perspectives discussed above may be attributable to researchers' contrasting philosophical positions. Undertaking educational research necessitates adoption of a philosophical stance which will subsequently influence the formulation of research questions and methods used to address those questions.

Acceptance of the research for education perspective could be accused of simplifying education into a matter of cause (i.e., teaching) and effect (i.e., learning) which may be associated with a positivist epistemology (Chatterji, 2004). This is an overly-simplistic view because, as previously highlighted, education is a complex phenomenon with various influential context-specific variables. For Langridge and Hagger-Johnson (2009) there is no single positivist stance; positivism has been conceptualised with varying sophistication. Collectively positivism provides a traditional view of 'science' emphasising the application of rigorous, systematic, and objective procedures to obtain valid and reliable knowledge (Giangreco & Taylor, 2003). Positivists are also said to subscribe to the notion of a single reality thereby depicting an uncomplicated relationship between that reality and our perception of it. Consequently, it is considered feasible to describe and explain reality in an unbiased and impartial way providing systematic, objective, and rigorous methods are adopted (Onwuegbuzie, 2002).

The single-reality concept is problematic for constructivist and interpretivist purists who argue for the existence of 'multiple-constructed realities' which render time- and context-free knowledge, appropriate for generalisation across teachers, unobtainable (Burke Johnson & Onwuegbuzie, 2004; p. 14). However, while governments encourage the production of research that seemingly subscribes to the single-reality perspective then teachers are more likely to be provided with, and encouraged to use, research which neglects unavoidable intricacies and complexities that they experience within their practice. Intricacies of teaching practice aside, Onwuegbuzie (2002) highlights concern about adopting a goal of objectivity from research-based knowledge, arguing that there are many subjective decisions made during investigation (e.g., identifying 'important' areas to study, interpreting analyses, and determining aspects of research worthy of publication). Acceptance that researcher values are influential in those decisions necessitates a concession that said values will also influence the knowledge subsequently created and provided to teachers. Kincheloe and Tobin (2009; p. 513) argue that 'many of the tenets of positivism are so embedded within Western culture, academia, and the world of education that they are often invisible to researchers and those who consume their research'. Despite that, they argue that most educational researchers refrain from explicitly conducting inquiry from a positivist perspective perhaps for fear of 'name-calling' (p. 514) due to the negative connotations associated with it.

Several authors (e.g., Biesta, 2010; Elliott, 2001; Hammersley, 1997) highlight concern about favouring research methods perceived to align with positivism. Tripney et al (2014), however, provide evidence that the government ambition for research-informed education has resulted in privileging quantitative research methods. For example, RCTs are considered by some (i.e., Torgerson & Torgerson, 2001; Goldacre, 2013; Connolly, Keenan, & Urbanska, 2018) as the 'gold standard' of research designs in identifying 'what works' in raising student achievement. RCTs are quantitative, comparative, controlled experiments, which can theoretically establish effect sizes with less bias than alternative research designs (Stolberg, Norman, & Trop, 2004). The rationale underpinning RCTs is simple: measure progress of students using an intervention against a control group of equivalent students (Connolly et al, 2018). Randomisation of participants across groups is unique to RCTs in identifying intervention effects and mitigating confounding and extraneous variables (Hanley et al, 2016).

In critiquing privilege of quantitative research methods, it is worth highlighting that their proponents often emphasise the importance of also using qualitative approaches where appropriate (e.g., Allen, 2013). Whilst providing arguably less robust (using a traditional definition) or generalisable knowledge, qualitative research can offer richly-detailed knowledge which is sometimes better placed to explain phenomena. Furthermore, based on a literature review, Ailinger (2003) concludes that qualitative research has made a substantial contribution to developing evidence-based nursing. Qualitative research's strength partially lies in the holistic viewpoint researchers take which can often more appropriately account for intricate contextual variables. Wrigley (2018) contends that policy-makers are devaluing the role of qualitative research methods. However, based on the preceding discussion, it seems they may be equally well placed to provide teachers with knowledge useful for guiding their practice and contribute to developing research-informed education.

Wrigley (2018) also argues that the conceptualisation of a 'gold standard' research design has resulted in further neglect of other research methods. To provide some evidence, Bennett (2013) attacked the usefulness of any educational research conducted using a non-RCT design and his stance was soon endorsed by former schools minister, Nick Gibb (Gibb, 2015). Publication of this message by two highly-influential figures may conceivably result in teachers dismissing useful knowledge purely because it has been acquired through methods other than the 'gold-standard'. Furthermore, a 'gold-standard' design could result in teachers being expected, but inadequately equipped, to critically evaluate and discriminate between that which does and does not meet the criteria (Pampaka, Williams, & Homer, 2016).

Hanley et al (2016) develop the criticism of RCTs as a 'gold standard' stating that logistical limitations within education often hamper their theoretical strengths. Researchers are often unable to effectively: a) standardise conditions across groups or settings, and b) implement student and/or teacher blinds. Building on the first point, Wrigley (2018) argues that within education there cannot be a consistent control condition because students are pre-allocated to cohorts, and routines and practices will pre-exist. This is quite different from medical contexts where participants can be allocated to a group from the outset of investigation. Besides being ethically questionable, re-allocating students would result in awareness of change thereby making student blinding difficult to operationalise (Sullivan, 2011).

Olson (2004) further criticises the use of RCT's within education because they: a) are limited to describing the impact of *x* versus *y* on *z,* and b) often encompass relatively large samples across multiple settings which can conflate contextual characteristics. Recruitment of large samples from multiple settings can, however, safeguard against accidental findings (e.g., type I errors). This critique of RCT's as a 'gold-standard' is not an attack on their usefulness for providing robust and somewhat generalisable knowledge, however, it should contradict Bennett's (2013) assertion that other research designs are worthless.

Slavin (2004) provides evidence that RCTs within education have historically been rare, 3 of 112 publications within the influential American Educational Research Journal between 2000 and 2003 met RCT criteria. Connolly et al (2018) recently reported a marked increase internationally in educational research RCTs with 78% of 799 studies identified since 1980 having been conducted between 2007 - 2016. Despite implementing mechanisms to encourage RCTs, only 13% ($n$ = 131) were conducted in the UK. Of interest, 32% ($n$ = 326) were conducted in secondary schools but only 28% ($n$ = 289) took place over one academic year or longer. The latter finding is concerning because treatment effects can take substantial periods of time to manifest. Perhaps allaying concerns that RCTs necessarily subscribe to a simplistic cause & effect perspective, over 25% of identified RCTs included some form of qualitative component. Connolly et al's (2018) research provides two particularly relevant findings: a) RCTs may be capable of identifying causation and accounting for education's complexities, and b) the knowledge created through RCTs is simply too thin for teachers to rely on, especially if they are looking for knowledge created in contexts similar to their own.

Beyond RCTs, quantitative syntheses (e.g., Hattie, 2009) of educational research are perhaps the next research-type being most intensely promoted which, for Wrigley (2018; p. 359) is a consequence of the current 'cultural status of numerical data being presented as objective, unmediated, unbiased and scientific carriers of facts'. The rationale behind quantitative syntheses is that teachers can access the collective outcome of a body of research on a given topic within a single resource. Ostensibly, this is promising because it would enable teachers to find out 'what works' without having to access, read, understand, and evaluate individual investigations, thus saving them substantial amounts of time and facilitating reduced research literacy.

Wrigley (2018) cautions against illustrating a breadth of evidence through statistical averaging largely because it (again) necessitates conflating intricate context-specific variables which, for teachers, could increase the risk of findings being mistranslated. Further complicating matters, research syntheses' inclusion criteria can be determined through technical (e.g., statistical) rather than substantive standards, resulting in contextually dissimilar investigations being compared. Although some methods of syntheses (e.g., meta-analyses) are designed to tolerate some disparity between investigations, problems may still arise from aggregating statistical results (e.g., effect sizes) derived from investigations which: a) adopt different conceptions or definitions, or b) focus on different curriculum areas, student ages, and/or academic levels. Again, this discussion is not an attack on the useful of research syntheses for providing teachers with a snap-shot of educational research findings. However, caution should be exercised in presenting them as 'a faithful mirror of the real world rather than an approximate sketch' (Wrigley, 2018; p. 364). Pawson (2006) previously argued that a more complete reflection of 'reality' within education may be seen through an evidence-base that encompasses a broad spectrum of methodologies. Perhaps on that basis, Hanley et al (2016) promote the use of a pragmatic approach to research which advocates determining a research method based on the research questions being asked.

To better ensure that knowledge created through educational research is useful for teachers, closer alignment between the values that researchers and teachers have in research are crucial. For Cherney et al (2012; p. 23) the current disparity is attributable to the two agents living 'in different worlds with differing languages, values and professional rewards'. As will be explored more comprehensively later in section 3.4.2, teachers generally value research which provides practical relevance and is constructed to align with conventional empirical inquiry. The latter largely relates to quantitative, experimental, theory-testing research. In contrast, researchers are said to value: 'the role of theory, data quality and robust research methods' (Cherney et al, 2012; p. 23; Oancea, 2005).

Nutley, Walter, and Davies (2007) and Nelson and O'Beirne (2014) suggest that the disparities discussed above could be a product of a traditional linear, top-down approach to research production which has provided researchers with autonomy and little accountability to teachers. Hargreaves (1996) earlier made a similar observation, complaining that the 'fatal flaw' of educational research was that ‘it is researchers, not practitioners, who determine its agenda’ (p. 3). Nutley et al (2007) and Nelson and O’Beirne (2014) instead promote a collaborative model encompassing a two-way flow of information between researchers and teachers thereby affording teachers greater influence in the construction and development of mutually useful educational research. Several of the initiatives discussed in the previous chapter have been implemented to enhance collegiality in research production, dissemination, and consumption, perhaps working towards the type of framework promoted above. Cherney et al (2012; p. 24) criticise that perspective for being ‘inherently problematic’, overly-simplistic, and failing to address ‘individual and institutional constraints’. It is perhaps for these reasons that according to Gough (2013) many initiatives have been ineffective. For Nelson and O’Beirne (2014), a coherent system for effective transfer of research-based knowledge into teachers’ practice remains absent.

Nelson and O’Beirne (2014) further hypothesise that the perceived gap between knowledge provided through educational research and that which is useful for teachers’ practice may be narrowed if both parties were less reluctant to stray from their ‘natural comfort zone’. Teacher expertise lies in pedagogy and, despite their increasing willingness, they may not be sufficiently equipped ‘reach backwards’ into research activity (e.g., Everton, Galton, & Pell, 2002; Beycioglu et al, 2010). Similarly, Nelson and O’Beirne (2014) argue that researchers are apprehensive about ‘reaching forward’ and attempting to translate research-based knowledge into a realm (i.e., classrooms) they are less familiar.

The previous paragraph may explain a common criticism (e.g., Vanderlinde & Van Braak, 2010) levelled at educational researchers that research is often conducted for self-benefit and that of the research community rather than to directly improve education. Stevens (2004; p. 302) indicated a similar criticism stating that, following publication in ‘prestigious journals’ researchers often ‘move on to the next study rather than attempting to relate their findings to the lives of teachers’. Researchers’ preference for publication in ‘prestigious journals’ may be attributed to perceptions within academia that publication in practitioner journals is less worthwhile and bears fewer professional credits.

Without being excessively critical of researchers, Cordingley (2008; p.37) points out that they also experience practical limitations, stating that 'conventional research outputs are, perhaps inevitably, significantly shaped by the requirements of research funders and research assessment systems'. Although they may enjoy some autonomy in planning and conducting research, Cordingley (2008) acknowledges that research must satisfy: a) funders, b) established research publication process, and c) accountability systems.

In summary, it appears that educational research can create knowledge that is potentially useful for teachers to use in guiding their practice. However, there is considerable disagreement as to whether that is, or should be, its main goal. Furthermore, even when researchers accept that as a worthwhile goal, the infrastructure that supports research tends to encourage researchers to focus their dissemination towards other researchers rather than teachers. On that basis, it seems logical to conclude that whilst some educational research is potentially useful for teachers, not all is.

### 3.3. Schools Facilitate Educational Research Engagement

The previous section illustrated that educational research can be constructed with the intention of providing knowledge useful for teachers to use in guiding their practice. To facilitate teachers' engagement with educational research, it follows that the institutions in which they operate (i.e., schools) should support them in doing so. Problematically, for Hemsley-Brown and Sharp (2003; p. 462) 'the conclusions from empirical research... confirm that the main barriers to knowledge use in the public sector... originate in an institutional culture that does not foster learning'. For Dimmock (2016), schools are no exception hence his suggestion that they must develop cultures which promote teacher learning for research-informed education to progress. This section will discuss steps that schools can take in promoting research-informed education and an overview of research investigating the extent to which schools have developed cultures conducive to developing research-informed education.

Coldwell et al (2017) describe a research-informed school as one in which research is integrated 'into all aspects of their work as part of an ethos of continual improvement and reflection' (p.7). Brown and Greany's (2018; p. 118) definition is not dissimilar, describing a research-informed school as one where 'there is a deliberate strategic and developmental approach toward fostering evidence-informed practices and cultures across all staff'.

Coldwell et al's (2017) research will be regularly referred to throughout this chapter because it is highly relevant to this investigation. Commissioned by the DfE, Coldwell et al (2017) adopted a multi-faceted 'pragmatic' (p. 5) approach to evaluate progress made towards developing research-informed education which included the following research methods:

- A literature review examining the relationship between research engagement and teaching practice
- Interviews with leaders of seven projects designed to promote research-informed education
- Content analysis of literature within the public domain (e.g., governmental policy documents; 165 school websites)
- 82 qualitative interviews with teachers with different levels of seniority from 15 schools.

Coldwell et al's (2017) findings are reported separately at individual (i.e., teacher) and institutional (i.e., school) levels and will be discussed during the relevant sections of this chapter.

Godfrey (2016) promotes several potential benefits for schools of developing a research-informed culture. For this investigation, the most relevant of those is to positively impact teaching practices and subsequently increase student achievement. He further proposes that a research-informed culture can enable schools to become more 'internally accountable' by using research-based evidence: a) as a robust basis for their decision-making rather than conforming to protocol set out by agencies such as Ofsted, and b) to create their own success criteria rather than basing success solely on league table performance.

Cain (2018) proposes that effective research utilisation can facilitate schools developing the type of culture described by both Coldwell et al (2017) and Brown and Greany (2018) through: informing decision-making, challenging teachers' mindsets, and developing intelligent communities. Cain's (2018; p. 11) research was based on interview data collected during from 153 teachers across '85 schools and colleges' during 'nine collaborative research projects [...] between 2013 and 2018'.

Perhaps the most well-documented mechanism for research to influence teaching practice is through informing teachers' decision-making, often by challenging their existing conceptions (Coldwell et al, 2017). This viewpoint is promoted by government who state that 'good decision-making should be informed by the best available evidence' (Cabinet Office, 2013). However, as established by Cain (2018) though 'simple and appealing' (p. 17), this process is more complex than acknowledged by government because whilst research can suggest one 'answer', multiple factors will influence the weight of evidence that teachers place on research when making decisions. Some examples of those factors may include evaluations of research robustness, perceived transferability of research findings, and congruity between research findings and experience. Research can also serve to develop 'intelligent communities' (Cain, 2018). An underlying principle here is that research engagement can influence a school's culture by infiltrating their 'structures and systems' (Brown and Greany, 2018) to develop 'academic, more professional dialogue' (Cain, 2018; p. 71) resulting in: a) enhanced critical reflection, b) shared values and vision, and c) collective responsibility for learning (Stoll et al, 2006).

Recently, several frameworks have been proposed detailing approaches to develop a research-informed culture within a school. Cain's (2018) framework was adopted here and will be discussed hereon, but it quite closely resembles that created by Brown and Greany (2018). Cain (2018) highlights the importance of SMT: distributing leadership, supporting individuals, supporting groups, involving all teaching staff, and developing partnerships with external bodies. Each of which will be discussed in turn.

**3.3.1 Distributed leadership.** Cain (2018) and Brown and Greany (2018) agree that a research-informed culture is often initiated by a headteacher (or equivalent) who envisions a value in using research-based evidence to improve teaching quality and student achievement. Coldwell et al (2017) reinforce this, arguing that most teachers' value for educational research was largely mediated by the perceived value that respective SMT placed on it. Once established, this vision must be communicated to teachers in a way that creates a 'buy-in' and a shared value for research (Handscomb & Macbeath, 2003). Brown and Greany (2018) and Coldwell et al (2017) reinforce Cain's (2018) suggestion that schools can work towards this goal by distributing aspects of leadership thereby empowering teachers to contribute towards the development of a research-informed culture.

Despite the concept of distributed leadership being well-established within management literature, its application within educational (i.e., school) contexts and related literature is relatively novel (Hairon & Goh, 2015). Perhaps owing to its recency within the context of schools, Hairon & Goh (2015; p. 693) argue that the notion of distributed leadership remains 'elusive [...] in the way it is conceptualized and operationalized'. Lumby (2013) locates distributed leadership as an approach to understanding relationships between actions of leadership and the social environment. Harris (2008) offers the following characteristics of distributed leadership within schools which appear to remain common and prevalent across conceptual variations within current literature (e.g., Liu, 2020):

- Multiple levels of seniority involved in decision making
- Primary focus on improving classroom practice
- Involves formal and informal leaders
- Requires fluid and interchangeable leadership

With some regularity, researchers (e.g., Hulpia, Deevos, & Van Keer, 2011) have identified positive correlations between the extent to which leadership, 'particularly decision-making' (Hulpia et al, 2011; p. 728), is distributed against measures of teachers' organisational commitment and their perceptions about quality of teaching provision within schools. More relevant to the current investigation, several authors (e.g., Harris, 2008) have attempted to identify a relationship between constituents of distributed leadership and student achievement across various educational settings though the findings have been inconsistent.

Problematically, the variation with which distributed leadership is conceived has contributed to methodological inconsistency across investigations. For Hairon and Goh (2015), two methodological approaches have most commonly been employed to establish those links; the first broadly aligns with the approach taken in the current investigation and involves quantitatively measuring constructs of distributed leadership. The second approach gravitates around qualitative methods, particularly ethnographic field study. Despite varied success in identifying positive student outcomes following implementation, distributed leadership appears to be presented as a leadership ideal amongst some professional bodies as evidenced by the NCTSL (2008) publication: *Everyone a leader: Identifying the core principles and practices that enable everyone to be a leader and play their part in distributed leadership*. Similarly, several academics have also endorsed the implementation of distributed leadership practices; for example, Handscomb and Macbeath (2003) argue that developing features of a research-informed school is a long-term process possible only through a framework of distributed leadership whereby the responsibility for overseeing T&L is collective and involves teachers at all levels of seniority.

Based on case study research, Cain (2018) describes how a selection of secondary schools within England used characteristics of distributed leadership as part of their journey to becoming research-informed institutions. Within his research, several school leaders reported encouraging teachers to engage with educational research and consider subsequent findings in conjunction with other forms of data to which they had access (e.g., student data, exam results). School leaders reported that the outcomes of those inquiries play a prominent role in professional discussions which take place to inform the respective school's strategic direction. Perhaps the most important mechanism at play here is that teachers within these schools were both supported and empowered, and as a result they were proactive in 'bringing stuff in and sharing it with staff' (Cain, 2018; p. 78). By empowering teachers to have influence of that magnitude on school policy, school leaders reported 'transformation from an inwardly focused school to a thinking school' (Cain, 2018; p. 77)

Both Cain (2018) and the EDT (2016) suggest that appointing a research lead or similar is an increasingly common approach to distributing research-orientated leadership. The seniority assigned to the post may indicate the power distributed and predict their effectiveness. Following a survey, the EDT (2016) reported that research leads often had greatest influence in school policy when their role was at SMT level. However, more commonly, these roles were at middle-leader level and granted no budget or remuneration. Although this may purely be a consequence of necessary fiscal frugality, it may also reflect reduced value in the role of research. Nevertheless, impact on school policy and teaching practice in these circumstances was often limited, perhaps owing to a lack of proximity to SMT.

**3.3.2 Support for individuals.** Cain's (2018) suggestion that it is important for schools to support teachers in engaging with research is reiterated by Brown and Greany (2018). Discussion within this sub-section will introduce challenges faced by teachers in becoming research-informed (discussed more comprehensively in section 3.4.3). School support for teachers can manifest in various ways, perhaps the most fundamental approach as promoted by Brown and Greany (2018; p. 125) is through leaders 'making available and coordinating time and the space and budget'. In doing so, teachers can become better placed to engage with research whether through less formal (e.g., joining a school-based research group) or more formal routes (e.g., MA, PhD). For Cain (2018), higher degrees can contribute towards building a research-informed culture by sparking critical, professional dialogue amongst teachers.

Developing and maintaining relationships with universities may be crucial in providing guidance to develop robust research literacy skills amongst teachers enabling them to: a) identify and evaluate research, and b) contribute to transferring those skills across colleagues. University-based study can also afford teachers an opportunity to challenge their conceptions outside of the school environment. Although promoting post-graduate study amongst teachers can be useful in developing a research-informed culture, some important obstacles must be overcome (e.g., negotiating required financial and emotional investment). Though largely beyond the scope of this investigation, Dimmock (2016) also points out that schools can promote a research-informed culture by supporting teachers' engagement *in* research (e.g., action research).

**3.3.3 Support for groups.** Building on provision of individual support for teachers, Cain (2018) and Brown and Greany (2018) encourage SMT to promote and facilitate teacher research collaborations. For Brown and Greany (2018), these collaborations should be underpinned by school leaders' efforts to create an environment supportive of continuous and collegial teacher learning. Regardless of the arena utilised, the desired outcome remains increasing dialogue amongst teachers by affording opportunities to reflect upon and critically evaluate research.

Formal collaborative research engagement may be achieved through training programmes conducted in-house but delivered by universities (Dimmock, 2016). This approach may be more effective than traditional university-based training as teachers may feel more comfortable engaging in critical dialogue in a familiar environment. If the 'buy-in' from teachers within a school is strong enough then they may choose to form their own groups where they can select research to discuss and evaluate. Nevertheless, the effectiveness of these interventions will likely be enhanced by providing essential, practical support (e.g., access to academic resources, time) mentioned earlier.

**3.3.4 Whole staff involvement.** Beyond individual and group support, Cain (2018) found that it is equally important that all teachers benefit from the school becoming research-informed. To achieve that goal, research should become 'part of the way things are done' (Brown and Greany, 2018; p. 123) by infusing it into the daily routine of teachers. Cain (2018) observed that schools attempted to achieve this predominantly through less formal strategies including 'speed-dating' exercises and utilising staff meetings as forums for research-based discussion. More formally, schools can facilitate arenas (e.g., staff development days) that enable teachers to 'showcase' research to colleagues. Problematically, 'speed-dating exercises' may not enable the extended dialogue and reflection necessary for meaningful research engagement.

Cain (2018) notes that schools sometimes support teachers in presenting research to colleagues through school-wide publications or further. This would increase demands placed on teachers, but it would also afford their colleagues an opportunity to revisit presented research thereby further facilitating academic dialogue. The approaches discussed here are not exhaustive and may take place using different formats (e.g., school collaboration meetings). Coldwell et al (2017) argue that adoption of strategies such as these appeared to take place in highly research-informed schools and filter through all teaching staff, often resulting in dialogue debating the weight of evidence for or against a particular intervention in a given situation.

**3.3.5 Partnership with external bodies.** Perhaps the most common route schools take to build a research-informed culture is through building mutually beneficial relationships with universities (Coldwell et al, 2017; Cain, 2019). As in this investigation, university-based researchers often recruit teachers from schools with which they have a working relationship when conducting research. Brown and Greany (2018), and Cain (2019) highlight several benefits of those collaborations for schools, including; access to academic resources sometimes with guidance about how to use them, universities undertaking literature reviews to support teacher research, university tutors contributing to the research-literacy of staff, increased opportunities to partake in research supported by quality assurance protocols, and possible influence in the research direction.

Based on five qualitative research projects, Cain (2019) reports that school-university relationships are developed for a broad range of purposes including provision of post-graduate study, university- and teacher- research projects, research dissemination. Although, these activities might ostensibly appear to promote more regular and higher-quality research engagement, Cain (2019; p. 99) reports that such relationships ‘are founded on activities that are declining, short-term, and heavily rely on the enthusiasm of a few people’. He goes on to provide evidence that some teachers and SMT’s appear hesitant about the usefulness of relationships with universities with some placing value on the prestige that can come with said partnerships. Others appeared to promote and contribute towards the perception that universities are too far removed from school environments to provide knowledge that is useful in enhancing practices withing schools.

Schools may also participate in cross-school collaborations and research projects with independent agencies (e.g., EEF), often to develop elements of practice or curricula. Problematically, as discussed in the previous chapter, current policy promotes school accountability, competition, and autonomy. These values may indirectly encourage inter-school competition thereby potentially contravening collaboration prospects (Godfrey, 2016). Increasing pressure for cross-school collaborations may also become unmanageable for schools' labour-force rendering them unable to maintain collaborations at a meaningful level (Brown & Zhang, 2017). Research Schools have been created to work with schools to help them make better use of research evidence in informing policy and practice and they sometimes do that through facilitating professional development training events for teachers (Research Schools Network, 2019).

Brown and Greany (2018) investigated the extent to which 79 primary schools have developed a research-informed culture. Through a literature review, they formulated a framework for developing a research-informed culture which revealed the following factors: a) developing a capacity to engage both in and with research evidence, b) making research-use a cultural norm, c) using research to create an effective learning environment, and d) using research to support structures and processes. This framework formed the basis of a 14-item survey distributed to teachers within participating schools at the beginning of a two-year investigation (2014-2016). Responses were received from 60 schools which formed Research Learning Communities (RLC) and 19 schools which acted as a control group. It is unclear how schools were allocated to conditions. The disproportion across condition sample sizes was due to all RLC schools providing survey responses but only approximately 50% of control schools responding. The quantity of missing data from the control group raises concern about the validity and reliability of subsequent findings.

The survey was piloted with primary school teachers not included in the investigation and constructed in consultation with a subject-matter expert to 'test face and construct validity' (p. 128). Scale reliability statistics are not provided therefore we cannot examine internal consistency and intra-factor item convergence. The 14-items within the survey were positively phrased and over 75% of participants agreed or strongly agreed with nine items, over 50% agreed or strongly agreed with the remaining five. Broadly speaking, these findings provide a positive image about the extent to which primary schools have developed a research-informed culture.

The authors acknowledge several limitations of their findings; firstly, their investigation focused solely on primary schools and we cannot be sure that their findings would be replicated in secondary schools. Secondly, participating schools were 'likely more predisposed to research engagement than the majority of England's primary schools' (p. 132) because: a) they signed-up to engage with research for two years, and b) 40 participating schools were (or were about to become) part of a teaching school alliance. Additionally, their analysis involved conflating responses within schools and across conditions leaving us unable to identify either: a) intra-school differences, or b) pre-existing inter-school differences.

To conclude this section, Coldwell et al (2017) report that although there was evidence of schools increasingly facilitating research-informed education over the course of their two-year investigation, for research-informed education to prevail 'government policy needs to be more strongly aligned with research evidence' (p. 8). The concept of schools developing a research-informed culture remains relatively new and, as reported by Cain (2016b), the weight of empirical research in this field has focused on research engagement at an individual (i.e., teacher) rather than institutional (i.e., school) level. Consequently, current evidence suggests that 'few educational environments are favourable to high levels of policy, research and practice articulation and alignment' (Dimmock, 2016; p. 50) and we cannot be sure of a subsequent impact on student achievement (Brown & Greany, 2018).

Several approaches to developing a research-informed culture have been discussed and, although separated for clarity, they are linked. For example, there is broad agreement that schools will likely be better placed to provide more effective support for teachers by creating partnerships with universities. Further agreement can be seen in the proposition that developing a research-informed culture requires a reconceptualization of learning in a way that infuses research in to teachers' daily practice rather than an isolated action on specific days or by specific teachers.

### 3.4 Teachers Engage with Educational Research

The previous section illustrated the importance of schools taking steps to both promote and develop a culture which promotes becoming research-informed. This section will discuss teacher engagement with educational research at the individual level by exploring the following assumptions:

1. Teachers value and engage with research
2. Teachers value specific research characteristics
3. Teachers face obstacles when engaging with research

There is expectedly overlap between relevant studies in their RQs and, as such, most investigation being discussed in this section will appear more than once. A brief overview of each investigation's research methods will be outlined in its first mention.

**3.4.1 Teachers value and engage with research.** Beycioglu et al (2010) distributed questionnaires to 250 secondary school teachers in Turkey to determine whether, why, and how they engage with educational research. Most (68%) participants reported that they had engaged with educational research, however, the remaining had never 'seriously considered' (p. 1090) doing so. Teachers most commonly accessed academic journals (28%), books, and in-service training courses to maintain currency with educational research. Everton et al (2002) earlier reported similar findings with teachers most commonly looking to in-service training, publications from governing bodies (e.g., DfES, Ofsted), and books. On that basis, Beycioglu et al (2010) argue that teachers are increasingly willing to engage with educational research closer to its original source which may be construed as evidence that mechanisms implemented to promote research-informed education (see section 2.4). Notably, Everton et al's (2002) sample was recruited from the UK therefore conflicting findings may be attributable to contextual (e.g., political) differences between the two samples. For example, the duration, intensity, and initiatives implemented to encourage research-informed education within England may differ from those in Turkey.

Borg (2009) provides further evidence of teachers independently engaging with educational research based on questionnaires and follow-up interviews from 505 teachers of English from 13 countries (UK excluded). Interviews were personalised based on participant questionnaire responses. Utilising multiple research methods enables cross-validation of findings and a deeper, more holistic image of participant perspectives to be captured. Although only teachers of English were included, there is little reason to believe that their perspective would differ from teachers of other subjects. Few (4%) of participants reported having ‘never’ engaged with educational research, 29% reported doing so ‘rarely’, 52% ‘sometimes’, and 15% ‘often’. Borg (2009) acknowledges that these findings should be interpreted cautiously because of: a) ‘varying ways ‘often’ and ‘sometimes’ were interpreted’ (p. 376), and b) disparity in teachers’ perceptions about which activities constitute research engagement. He highlights caution about teachers accessing resources with content which often fails to meet research criteria (e.g., school newsletters) in endeavour to become research-informed.

As mentioned in section 1.1, the definition of research engagement adopted here is inclusive of less formal means (e.g., social media). Investigations discussed in this section thus far were conducted a decade (or more) ago and perhaps therefore opted against acknowledging using social media for research engagement. With that said, acknowledgement of social media in more recent investigations remains inconsistent. Whilst Nelson et al (2017) do not acknowledge it, Coldwell et al (2017), Boser (2019), and Richardson, Sauers, Cho, and Lingat (2020) do and each provide conflicting findings. Coldwell et al (2017; p. 26) report that teachers ‘drew on social media [...] for links to evidence sources and some used social media as a means of sharing evidence’ and Richardson et al (2020) discuss evidence that SMT use Twitter for similar purpose. Despite also finding evidence that teachers use social media to engage with research, Boser (2019; p. 11) reports that ‘professional development and conferences/ workshops’ remain the dominant means of research engagement. He fails to specify how many teachers in his investigation used social media for research engagement.

Coldwell et al (2017) found further evidence that 'most' of 93 teachers across 23 schools reported valuing educational research. Despite evidence that teachers value educational research, the extent of its influence in their practice remains questionable. Based on 509 teachers (61% of whom based in secondary schools) across 256 primary and secondary schools (*M* responses per school = 2 teachers), Nelson et al (2017) report that almost two-thirds testified to both 'valuing and engaging with research evidence' (p. 9) and using it 'to change classroom practice' (p. 19). Those findings are pooled across teachers in primary and secondary schools. Nelson et al (2017) found that secondary school teachers were significantly more likely to use educational research to inform teaching approaches than primary school teachers with a quasi-effect size = 0.3 (i.e., difference between mean scores of two groups divided by pooled standard deviation (p. 29)). The term 'quasi' is used to 'emphasise that these are not causal effects' (p. 29). Teachers in Ofsted rated 'Requires improvement' or 'Inadequate' schools reported more regular engagement with educational research than those in 'Outstanding' or 'Good' schools (quasi-effect size = 0.4).

Nelson et al (2017) also found that SMT reported placing greater value on educational research to inform practice than teachers. Consequently, teachers reported relying on internal (e.g., SMT) and external (e.g., EEF) intermediary bodies to facilitate research engagement. Based on a sample of 55 research lead's, Riggall and Singer (2016) provide further evidence of teachers looking to them as a research intermediary. Utilising research intermediaries is potentially problematic for several reasons: a) SMT sharing only research with teachers which supports their agenda, b) potential further distortion or misinterpretation of research findings, and c) disempowering teachers by stifling their research literacy.

Borg (2009) and Beycioglu et al (2010) also explored relationships between teacher demographics and their research engagement. Borg (2009) reports weak but significant positive correlations between regularity of teachers' research engagement and their experience and highest qualification. In contrast, Beycioglu et al (2010) report no statistically significant relationship between teacher experience or gender with regularity of research engagement or perceived value in guiding practice. Within England, we might expect that more recently-qualified teachers would engage with educational research following the impact of the governmental thrust towards research-informed education on ITT programmes. For example, the *Carter Review* (2015; p. 53) stipulates that 'the priority for ITT is to support trainees to become intelligent consumers of research' by providing 'the core skills of how to access, interpret and use research to inform classroom practice'.

Based on 1979 teachers in 66 high schools across USA, Lysenko et al (2014) create the following four-factor model which accounted for 63% of variance in teachers' educational research engagement: teachers' experiences of research use (9%), attitudes toward research usefulness (34%), research expertise (6%), and organizational support (12%). Each factor was individually a statistically significant predictor of research engagement. Borg (2009) earlier revealed the importance of institutional factors as some teachers seemed to address educational research only when specifically required to do so by their employer. Perhaps more concerning, 213 teachers reported engaging with educational research because 'it's good for professional development', their 'employer expects it' or 'it will help with promotion' (p. 372).

To summarise, there seems agreement that teachers within secondary schools internationally value educational research and engage with it at least 'sometimes' (Beycioglu et al, 2010; Borg, 2009), and there is some evidence that SMT value educational research more (Nelson et al, 2017). It is less clear which resources teachers use to engage with educational research because of inconsistencies between authors in activities which constitute research-engagement. However, based on the evidence available, in-service training and books seem most common (Everton et al, 2002; Beycioglu et al, 2010). However, given growth in social media usage and the findings of Coldwell et al (2017) and Richardson et al (2020), there is reason to believe that teachers may now increasingly turn to those platforms. There is some evidence of a positive correlation between the regularity of teachers' research engagement with their highest qualification (Borg, 2009) and seniority (e.g., Nelson et al, 2017), but evidence of a relationship with their age is mixed. There is also some evidence that teachers' research engagement is dependent upon their attitudes towards the usefulness of research and school support (Lysenko et al, 2014).

**3.4.2 Teachers value specific research characteristics.** Borg (2009) presented participants with 10 scenarios 'all describing some form of inquiry' (p. 365) and asked them to rate which scenarios most appropriately represented strong research. Teachers most commonly considered strong research to involve experiments, large sample sizes, researcher objectivity, statistical analyses, and publication in academic journals. The cited characteristics largely align with those promoted by government and the provided definition of positivism. Borg's (2009) findings were consistent across teachers from all countries however it is worth reiterating that teachers within the UK were excluded. Though there seems a common thrust towards research-informed education internationally, differences between nations in their thrust may influence teachers' perspectives.

Ratcliffe et al (2005) similarly conducted survey-based research but instead recruited primary and secondary school teachers of science within England. Similarly to Borg (2009), participants placed greater value on systematic, rigorous, and large-scale research relevant to their practice. They concluded that participants crave research demonstrating 'what works' but demonstrated little understanding of complexities of the research process. Teachers' desire for research to tell them 'what works' may reflect that teachers are 'dismissive of theories and concepts for their alleged remoteness from the 'real' school situation' and 'divorced from the real work of teaching' (Beycioglu et al, 2010; p. 1088). Several of those concerns have since been reiterated by secondary school teachers within England (e.g., Cain, 2016a).

There is substantial evidence to support Ratcliffe et al's (2015) conclusion that teachers want educational research to tell them 'what works'. Coldwell et al (2017) report that teachers' educational research utilisation is mediated by the extent to which it is 'problem and practice focused' (p. 7). Everton et al (2002) earlier reported that 'comparison of different instructional strategies' was most commonly perceived by teachers as the most important issue function of educational research. Beycioglu et al (2010) asked the same question and participants most commonly (32%) reported ‘teacher development’ as most important, ‘comparison of different instructional strategies’ (p. 1090) was most commonly reported as second most important.

Further supporting evidence that teachers want educational research to provide ‘what works’ was earlier provided by Gore and Gitlin (2004) following surveys administered to 232 teachers (85 of whom were trainee teachers) across the USA and Australia. However, participants acknowledged that the ‘uniqueness of teaching contexts […] makes it very unlikely that research will be helpful to their particular teaching situations’ (p. 41). With that said, assuming the contexts share basic similarities (e.g., mainstream, secondary schools) then we might expect similar effect sizes.

To summarise, a consensus appears present that teachers: a) value research conducted using methods aligning with conventional empirical principles, and b) want research they can use in a reasonably direct way to improve their practice. There is also some evidence that teachers acknowledge some difficulties educational researchers may face in meeting the demands of the latter (Gore & Gitlin, 2004).

**3.4.3 Teachers face obstacles when engaging with research.** Teachers in Borg’s (2009) investigation who reported ‘rarely’ or ‘never’ engaging with educational research generally pointed to lacking: time, physical and intellectual access, and practical relevance of research. Based on a survey across teachers in 10 primary schools, the EEF (2016) reported similar findings which have since been further reinforced by Coldwell et al (2017). These findings illustrate fundamental obstacles which may explain teachers’ reluctance to ‘reach backwards’ into research production. Researchers must take some responsibility here because criticism for using inaccessible language has also been lodged by peers (e.g., Hillage et al, 1998; Goldacre, 2013).

Nelson et al (2017) provide further evidence of teachers’ difficulty in understanding educational research as only 12% of participants reported it as being an information source ‘easiest to understand’. Participants more commonly reported colleagues (68%), student performance data (44%), and information from

CPD (43%) as being easiest to understand. For Coldwell et al (2017) and Everton et al (2002) this problem is exasperated for teachers without post-graduate qualifications who seem to have less confidence in engaging with educational research.

Teachers' lack of confidence is perhaps with good reason because their attempts to implement research-based knowledge into practice happen in only 'more or less systematic ways' (Coldwell et al, 2017; p. 7). Concern about teachers implementing research-based knowledge without sufficient precision has previously been raised by Smith, Daunic, and Taylor (2007) and can complicate subsequent attempts to replicate or compare interventions. Researchers should arguably accept responsibility for failing to provide sufficient procedural detail for interventions (Oancea, 2005; Huat See, Gorard, & Siddiqui, 2016). However, Leventhal and Friedman (2004) argue that rigid adherence to procedural guidance offered by researchers may: a) inhibit the influence of teachers' practical knowledge, b) encourage a mechanical, prescriptive approach to teaching practice, and c) stifle intervention development.

The final obstacle to be discussed centres on the challenge teachers face in balancing research-based knowledge with that developed through experience. Cain (2016a) provided 14 teachers across two secondary schools with three journal articles about curriculum, pedagogy and groupings for raising attainment of gifted and talented (G&T) students. Teachers were interviewed individually and observed in discussion groups to identify the influence research had on their thinking and practice. He reports that research-based knowledge which does not align with pre-existing conceptions is more likely to be rejected perhaps because 'almost all the teachers saw the authority of the published research reports as provisional' (p. 7). For Cain (2015a; p. 489), research-based knowledge acts as a 'third voice' 'subordinate to the 'first' and 'second' voices'. The 'first voice' articulates one's own values and knowledge acquired through previous experience of teaching practice, and the 'second voice' is that but of colleagues. Teachers attributed allocating little trust to educational research because of contradictions across research findings, questionable research methods, and lacking generalisability.

Nelson et al (2017) and Coldwell et al (2017) support Cain's (2015a, 2016a) observation that teachers consider research findings as provisional. Nelson et al (2017) found that teachers were more likely to adopt an intervention based on: pupil performance data, ideas generated by themselves or colleagues, CPD training, ideas from other schools, policy-based guidance (e.g., examination bodies, DfE) than one based on educational research. Coldwell et al (2017) report that teachers were unlikely to be convinced by research evidence alone, for it to carry weight then it needed to be reinforced by evidence obtained through: a) self-observation of impact in practice, or b) endorsement from trusted colleagues. Although few contest the value of teachers' experience-based knowledge in guiding teaching practice, this knowledge is considered to be unsystematic and lack rigour (Sebba, 2004; Leinhardt, 1990). Leinhardt (1990) recognises that acceptance of experience-based knowledge as useful in guiding teachers' practice is problematic for researchers because they then must determine what and whose experience-based knowledge is desirable and therefore should be explicated. Arguably all teachers, regardless of quantity of experience, may have developed potentially useful knowledge.

To summarise this subsection, practical and intellectual obstacles faced by teachers in engaging with educational research remain unchanged despite mechanisms to push research-informed education. This is concerning because, as highlighted by Cain (2016b), if teachers are unable to engage with educational research in a meaningful way then we should likely a subsequent lack of utilisation which may render mechanisms, such as those discussed in section 2.4, hopeless.

### 3.5 Educational Research Engagement Enhances Teachers' Knowledge

Despite mechanisms being implemented to encourage the production and uptake of useful educational research, the impact of teachers' engagement with research on their pedagogical knowledge is largely unknown (Brown & Zhang, 2015). Most research discussed within this section will identify the impact of research engagement on teachers' knowledge of findings about general well-established educational practices and findings from cognitive neuroscience. However, the initial investigation to be discussed – Flynn et al (2021) – identified the impact that research-informed subject-specific training can have on teachers' knowledge and subsequent implementation. As discussed earlier, government policy promotes the use of systematic synthetic phonics as the 'go-to' strategy for teaching children to read words.

Flynn et al (2021) conducted two one-day training events to which 584 from 379 schools across England attended. Quantitative data revealed that 53% of teachers reported that the training would 'change their thinking' and 62% reporting expecting an 'impact in their practice' (p. 8). 26% of teachers who attended the training event completed a survey one-year following the training events to identify 'whether and how they had been able to implement changes' (p. 11). Qualitative data revealed that few teachers appeared to value the 'why' of strategies discussed instead favouring the 'what' (i.e., the practical aspects) and appeared to retain more procedural information. Interestingly, few had been successful in implementing changes in practice within their respective settings and most of those attributed to lacking support from leadership.

Levin et al (2011) employed a pre-post mixed methods design to investigate the extent to which changes in 188 secondary school SMT's educational research-based knowledge impacted changes in policy and practice across schools in Canada. At pre-test, participants stated whether their 'current beliefs were consistent with available evidence' (p. 9) on six 'knowledge claims' about the provision of mainstream high-school education. Levin et al (2011) define a knowledge claim as 'a finding with strong support from empirical research' (p. 9); for example: 'Students who fail a single course in the first year of secondary school are at a much greater risk of dropping out of school'. Wide pre-test variation in agreement between participants' beliefs and research-based knowledge were observed (participant agreement with knowledge claims ranged between 24% - 94%). However, participants who more regularly agreed with knowledge claims reported more commonly engaging with research. These findings illustrate: a) broad divergence in the extent to which teachers agree with well-established educational research findings, and b) a positive correlation between engagement with educational research and agreement of those findings.

Following pre-test, one of the following interventions was implemented across each participating school: sharing research articles, study groups, or action research. Notably, interventions were reportedly rarely implemented effectively, and pre-test participant data was anonymous therefore we are unsure how many participants completed the full investigation because some may have dropped out and been replaced. At post-test, Levin et al (2011) reported 'relatively little change across the two surveys in responses to the six knowledge claims […} or in the use of research to shape opinion' (p. 18). Essentially, little success was achieved in using the interventions to enhance school leaders' knowledge of well-established educational research findings. This research suggests that school leaders' 'beliefs' are unlikely to be changed following exposure to educational research.

Most recently, Boser (2019) identified the extent to which 214 'college-level' staff (i.e., teachers, support staff, and administrators) 'agree' with: a) 'six strategies with well-established support in the literature' (p. 5) (i.e., elaboration, retrieval practice, metacognition, spaced practice, interleaving, dual-coding), and b) the following common misconceptions about the relationship between well-established neuroscience research findings and education (i.e., neuromyths): learning styles, right-brain/left-brain, purely genetically determined intelligence. To enhance the methodological quality of their survey, Boser (2019) randomised the order of questions and counter-balanced them. Notably, the response rate was below 50% therefore participants may be unrepresentative of the target population and perhaps illustrate only a subgroup who have an enhanced interest in being research-informed. Of the strategies with research support, Boser (2019) report that 'roughly 60%' (p. 10) correctly identified elaboration, spaced practice, and metacognition. However, only 31%, 26%, and 20% endorsed retrieval practice, dual-coding, and inter-leaving, respectively, as effective strategies. Learning styles and right-brain/left-brain neuromyths were endorsed by 97% and 77%, respectively. More promisingly, only 20% endorsed the idea that intelligence is strictly genetically determined. In all, educators' knowledge of research findings and neuromyths is concluded to be 'somewhat better than chance' (p. 12) though it is not clear how that was calculated.

Both Levin et al (2011) and Boser (2019) differ from the current investigation in that they asked teachers about the extent to which they agree or disagree with educational research findings. More alike this investigation, Nelson et al (2017) investigated the relationship between teachers' educational research engagement and their explicit awareness of (rather than their agreement with) research-based knowledge.

Similarly to Levin et al (2011), Nelson et al (2017) asked eight true/false questions to assess teachers' knowledge of 'teaching and learning or whole-school approaches with a strong, and relatively uncontroversial, evidence base' (p. 21). To my knowledge, this research is the first in England to objectively measure secondary school teachers' ability to identify well-established, research-based knowledge. Some items were identified correctly much more commonly than others (range = 13% - 67%). Zero teachers responded to all items correctly (*M* correct responses = 2.9) and they reportedly found questions requiring 'specific research or scientific knowledge' more difficult than those answerable 'based on judgement and experience' (Nelson et al, 2017; p. 34).

Teachers' research literacy was also investigated through a mix-and-match activity with three research problems (e.g., 'Provide an overview of the evidence base') and five research methods (e.g., literature review). Teachers were asked to identify the best method for each problem. Only 28% were able to identify the purpose of RCTs which, as highlighted by the authors, is interesting given their 'gold standard' status. These findings are pooled across primary and secondary school teachers.

In total, participants were asked 11 questions; eight to identify their explicit awareness of research-based findings, three to identify their research literacy. Taken together, secondary school teachers provided significantly more correct responses than primary school teachers (quasi-effect size = 0.3; calculation for quasi-effect size provided in section 3.4.1), and SMT performed significantly better than teachers (quasi-effect size = 0.7). Of further interest, approximately two-thirds of participants reported 'external research' as a component of evidence-based teaching and, compared with those who did not, they were significantly more likely to: a) have a positive attitude towards the usefulness of research to improve teaching practice (quasi-effect size = 0.5), b) actively engage with online evidence platforms (e.g., EEF Toolkit, 2018) (quasi-effect size = 0.4), and c) achieve a research knowledge score (quasi-effect score = 0.5). Finally, teachers in Ofsted 'Outstanding' and 'Good' rated schools revealed greater research knowledge than those in schools which 'Require Improvement' or are 'Inadequate'. Despite not reaching statistical significance, that finding is interesting because those in the latter category reported more regular research engagement (as discussed in section 3.4.1). Taken together, the above findings provide provisional evidence about a relationship between research engagement, research knowledge, and school effectiveness. Nelson et al (2017; p. 34) conclude that teachers demonstrated 'a highly variable..., but overall relatively low level of knowledge' of educational research findings and research literacy.

Several limitations of Nelson et al's (2017) study should be acknowledged. Firstly, this was a pilot study conducted to identify functionality of survey items therefore their findings are based on items which had not previously demonstrated validity and reliability. A factor analysis revealed a Cronbach's alpha score of 0.5, which is below Nunnally's (1978) broadly accepted threshold of 0.7. Furthermore, although they assert that the recruited school sample is 'broadly representative of all school types' (p. 7) only data categorising percentages of primary/ secondary schools and their respective Ofsted grades are provided. Detail about other measures (e.g., free-school meals, school type) which could be used to ensure sample homogeneity is omitted. Additionally, as acknowledged by the authors, a maximum of 5 teachers within each school were able to participate potentially resulting in a sample unrepresentative of the teaching population. This concern is exasperated as an average of only two teachers responded from each school.

Rather than investigating teachers' objective awareness of well-established educational research findings, most research has instead investigated their ability to identify neuromyths. Howard-Jones, Franey, Mashmoushi, and Liao (2009) conducted semi-structured interviews with teachers at various levels of seniority (i.e., trainee teachers to headteacher) to guide the creation of a survey consisting of 38 assertions (15 correct, 16 incorrect, 7 open to subjective opinion) to identify teachers' 'neuroscience literacy'. Of those, 16 'in the broadest sense, focused on learning' (p. 16) (e.g., 'Performance in activities such as playing the piano improves as a function of hours spent practising' (p. 35)), 15 represented common neuromyths (e.g., 'Differences in hemispheric dominance can explain individual differences amongst learners' (p. 34)), and seven were subjective assertions about the mind-brain relationship (e.g., 'The mind is the result of the action of the spirit, or of the soul, on the brain' (p. 33)). The survey was administered to 158 graduating PGCE students.

The mean number of correct responses from participants to the group of 15 and 16 assertions were 5.13 and 9.15, respectively. There was a moderate positive correlation between participants' knowledge of those subsets however, there was no relationship between neuroscience literacy and regularity of reading newspapers, science magazines, or books. That suggests that teachers' knowledge is unlikely to improve without engaging with neuroscience-specific texts. Howard-Jones et al (2009) report that participants' neuroscience literacy was similar to a sample of the public and that is problematic because those misconceptions may be detrimental to teachers' practice if implemented.

Using a survey incorporating many items formulated by Howard-Jones et al (2009), Dekker, Lee, Howard-Jones, and Jolles (2012) investigated 242 teachers from primary and secondary schools across the UK and the Netherlands' ability to identify neuromyths. Participants were required to identify: a) whether 32 statements (15 of which were neuromyths) relating to relationships between the brain and student learning were correct based on available evidence, and b) resources utilised to maintain currency with research-based knowledge (e.g., academic journals, CPD, science magazines). On average, teachers believed 49% of the neuromyths and seven of them were believed by more than half of participants. Reinforcing the findings of Howard-Jones et al (2009), there was no significant relationship between resources participants engaged with and their ability to identify neuromyths.

The research discussed thus far in this section arguably provides a simplistic perspective because of the complex way in which research-based knowledge influences teachers' knowledge. Cain (2015) conducted a qualitative investigation involving eight teachers from a single secondary school in England. Teachers were provided with research articles about G&T learners and asked to use the knowledge communicated through that research to design and conduct action research projects to 'improve their ability to challenge appropriately, their G&T students' (p. 498). Data was gathered through interviews with participating teachers, notes from monthly meetings, and teacher reports of the effectiveness of their inquiry. For Cain (2015; p. 498) the 'most significant finding is that every teacher in the study claimed that the research papers influenced their thinking and practice'. More specifically, research-based knowledge influenced both what the teachers thought about and how they thought. Cain (2015) made no attempt to identify teachers' objective knowledge of the research articles provided, however, for teachers to implement action research based on this research then the knowledge acquired through said research likely had some impact on their knowledge base.

To summarise this subsection, teachers' explicit knowledge of well-established educational research findings and neuromyths appears to be 'highly-variable' but generally 'show a weak conceptual understanding of current research knowledge' (Nelson et al, 2017; p. 24). Levin et al (2011) and Nelson et al (2017) provide some evidence that SMT may be better placed to identify well-established research findings. Aside from Cain (2015) and arguably Nelson et al (2017), the evidence discussed suggests that engagement with research has little bearing on teachers' ability to identify well-established educational research findings or neuromyths. However, serving to introduce the next section, Cain's (2015) research provides an illustration of the complex ways research-based knowledge can influence and enhance the bank of knowledge that teachers draw upon to guide their practice.

## 3.6 Teachers Use Educational Research to Guide Practice

Coldwell et al (2017; p. 6) rightly contend that research access, engagement, and use are closely 'intertwined'. The ways and extent to which teachers use research-based knowledge to influence their practice is undoubtedly important in determining the success of research-informed education. There is a consensus amongst academics that research-based knowledge can contribute to improved teaching practice and there is some correlational evidence to support it.

Using a sample of 485 ‘early childhood’ teachers of English in USA, Piasta et al (2020) examined the relationship between teachers’ ‘content knowledge’ (i.e., knowledge about language development), awareness of well-established educational research findings concerning the ‘practices to support children's language and literacy skills’ (p. 142), observed classroom practices, and the literacy achievement of 2004 children in their classrooms. Analyses revealed small but significant positive correlations between measures of classroom practice and both educators' content knowledge and awareness of research findings. The relationship between teachers’ awareness of research findings and student achievement will be discussed in a later section.

Despite some emerging empirical evidence of a relationship between teachers’ awareness of well-established educational research findings and the quality of their practice, Van Schaik et al (2018) and Cain et al (2019) argue that we remain unsure about how teachers use research-based knowledge. Furthermore, the frameworks commonly used are drawn from research utilisation in medical contexts and problems with the extent to which education can or should mimic medicine have already been discussed. Ion and Iucu (2014) discuss perhaps the most commonly used framework which classifies research use as being either: instrumental, conceptual or strategic.

The ‘instrumental’, or ‘engineering’ model is desired by some proponents of research-informed education (e.g., Hargreaves, 1996; Goldacre, 2013) and illustrates the direct transfer of educational research findings into schools to solve practical problems which teachers face. Weiss (1979) describes two variations of this model: the ‘proactive’ version advocates conducting research to resolve perceived problems. The ‘reactive’ version is the use of existing research-based evidence to resolve perceived problems. The instrumental view of transferring research-based knowledge into schools and teachers’ practice has been criticised as too simplistic and implausible (Biesta, 2010; Cain, 2016b).

The ‘conceptual’, or ‘enlightenment’ model (Weiss, 1979), share similar characteristics essentially suggesting that educational research should generate theory which can then impact educational policy and practice indirectly by questioning and sharpening teachers’ thinking. This approach emphasises the significance of ongoing communication between research producers and research users. Importantly, adoption of this model necessitates acceptance that educational research is not a short-term fix for teachers' practical problems. Cain (2015a, 2015b) illuminated this process using teachers from two secondary schools by examining how research-based knowledge was incorporated into practice. Based on data gathered from interviews and focus groups over a 12-month period, participants understood new research-based knowledge by assimilating and associating it with their pre-existing knowledge before 'diffusing' underlying principles into their respective context. Cain (2015a, 2015b) observed that through extensive dialogue both internally and with colleagues, participants developed experience-based concepts using those communicated through research. The recruited sample size was relatively small therefore generalisability is limited, although Huat See et al (2016) and Coldwell et al (2017) provide further evidence of conceptual research use. The former report that teachers navigated a 'difficult' and 'complex' process in transferring research-based knowledge into their practice. Coldwell et al (2017) report that knowledge accessed through research was commonly 'integrated' (p. 6) to 'experiment, test out and trial new approaches' (p. 8) in their practice.

Nutley et al (2007) propose a relationship between 'instrumental' and 'conceptual' uses of research, suggesting that initial engagement with research can serve as a trigger to practical action. Essentially, they suggest that by engaging with research, teachers become aware of the respective findings and internalise them before reflecting on the extent to which they perceive those findings could be contextualised within their practice. Assuming teachers are successful in each of those steps, there is then an increased likelihood of a subsequent attempt to implement those research-based principles into practice.

Finally, the 'strategic' model posits that findings are used by research users to justify their decisions. For McMillin (2012), this approach is commonly adopted by those looking to provide evidence to support a strategic or philosophical shift in educational policy. Wyse (2017) cautions that this use of research brings a risk, particularly to policy-makers, of making decisions based on individual pieces of research that support preferred policy direction rather than objectively evaluating a breadth of research. Reinforcing his concern, Wyse (2017) points to current government policy of favouring synthetic phonics despite, as discussed in section 2.1, Torgerson et al (2018) finding ‘little evidence’ in favour of any single method. Torgerson and Torgerson (2001) earlier rightly stipulated that the complexities of research mean policy-makers’ evaluation of research-based evidence should be done in consultation with people who possess expertise in research methodologies and teaching experience.

The research discussed in this section largely provides evidence that educational research-based knowledge can be used by research users to guide their practice. It seems that teachers most commonly make sense of research and use it in alignment with the conceptual model. This reinforces a fundamental principle of research-informed education that teachers’ practice cannot be based on educational research but can be informed by it. However, as previously highlighted, some government initiatives have seemingly been created with an instrumental view of research utilisation in mind.

### 3.7 Being Research-Informed Positively Influences Student Achievement

Despite a growing body of research, there remains ‘thin’ (Coldwell et al, 2017; p. 21) evidence that research-informed education will enhance student achievement. In the previous section, Piasta et al’s (2020) research examining the relationship between teachers’ content knowledge, awareness of well-established language and literacy skill development research findings, observed classroom practices, and literacy achievement was discussed. They report small (i.e., coefficients <.10) positive correlations between awareness of research findings and three out of four measures of literacy achievement.

Huat See et al (2016) report a pilot study exploring the experience of teachers engaging with educational research in an attempt to implement research-based teaching principles and raise student achievement. Their quasi-experimental investigation included 1677 students across 9 primary schools in England over one academic year. Participants were required to engage with feedback-related research and use the findings to enhance the feedback provided to learners. The subsequent impact on student achievement was measured by comparing test results from participating schools to 49 ‘similar schools in the locality’ (p. 61). Although their main aim was not about the impact of enhanced feedback on student achievement, sufficient information was provided to make inferences. Here, achievement of only Year 6 students will be discussed because only they conducted standardised assessments. Intra-school differences were also observed by comparing experimental cohort achievement with prior cohorts. Tests of statistical significance were not conducted because ‘the cases being compared were neither randomly selected nor allocated’, and ‘they also take no account of sample quality or attrition’ (p. 62). Students in the intervention cohorts made marginally larger gains across reading, maths and writing compared with the compared schools (overall effect size = 0.06), individual effect sizes are not provided. Increased benefits were observed for socio-economically disadvantaged students across all three subjects: reading (effect size = 0.17), writing (effect size = 0.12) and maths (effect size = 0.41). However, because of a small sample of disadvantaged students and teachers not being blind to condition, results should be treated cautiously.

Wiliam, Harrison, and Black (2004) carried out a similar investigation, requiring 22 teachers from six secondary schools to engage with feedback-related research and apply underlying principles into their practice. The dependent variable was student achievement and they report an overall effect size of 0.32 but noted that effect sizes were most promising for students whose achievement measure was standardised (i.e., GCSE students). Wiliam et al (2004) acknowledge inconsistency in comparisons across groups and consider this investigation as a series of ‘separate mini-experiments’ (p. 63). The comparisons generally included the same teacher teaching an ‘equivalent’ class from previous years or a different teacher teaching an ‘equivalent’ class. Little information is provided to examine the true equivalence of those classes.

On behalf of the EEF, Rose et al (2017) conducted an RCT aimed to improve teachers’ practice and subsequently student achievement by ‘raising teachers’ awareness, understanding, and use of educational research’ (p. 4) through RLCs. Alike the perspective taken in this investigation (see Chapter Four), Rose et al (2017) theorise that supporting teachers’ access, understanding and utilisation of educational research to inform their practice will positively influence their dispositions towards the usefulness of research. It was subsequently expected that a change in teachers' practice would positively impact student achievement. A total of 5462 students across 60 primary schools were randomly allocated to one of 14 RLCs and 59 primary schools formed a control group (i.e., 'business as usual' (p. 6)). Two teachers from each school (usually SMT) in the RLC condition attended four workshops each facilitated by a researcher during one academic year to discuss literature about an agreed area of interest (e.g., improving literacy through growth mindsets). Participants were then tasked with using information from workshops to: a) implement strategies within their school to raise achievement, and b) support colleagues in 'raising their awareness, understanding and use of research' (p. 5). To evaluate the effectiveness of RLCs, two outcomes were measured: a) KS2 achievement in reading, numeracy, and grammar scores using standardised assessments, and b) teachers' dispositions towards, and engagement with, research through self-report surveys. Due to inherent flaws in subjective measures (e.g., social desirability), attention will predominantly focus on the impact that RLCs had on student achievement.

The validity of Rose et al's (2017) investigation is strengthened because: a) of a low attrition rate (six schools dropped out), and b) students across conditions being relatively similar in terms of free-school meals and prior attainment. Treatment fidelity (i.e., the accuracy and consistency of interventions implemented during investigations) was measured through attendance at workshops which may not be a particularly robust measure. There is no evidence that RLCs positively impacted KS2 reading and only marginal positive impacts on KS2 numeracy (effect size = 0.06) and grammar achievement (effect size = 0.10) were observed. Given the relatively short intervention period, even a small effect size is encouraging. Arguably reinforcing governmental thrust towards encouraging teachers' educational research engagement and utilisation, further analysis revealed a significant relationship across both conditions between research engagement and student achievement for KS2 reading and numeracy though effect sizes remained small (i.e., < 0.10). Reinforcing discussion in section 3.3, Rose et al (2017) argue 'the most important (factor) was that schools had a research-friendly culture' (p. 47) before requesting further research investigating the long-term impact of developing a research-informed culture on teaching practice and student achievement.

In summary, most research discussed in this section offers some evidence of a relationship between teachers' awareness of educational research findings and student achievement. The coefficients obtained have consistently been small thereby suggesting that there are other meaningful factors at play in determining student achievement beyond being research-informed. Problematically for researchers, given the complexities of T&L there various methodological and conceptual obstacles that researchers face in identifying causal relationships between the extent to which teachers are research-informed and student achievement.

## 3.8 Summary

However contentiously, education is being driven towards becoming a research-informed practice under the premise that research can provide teachers with evidence about 'what works' in the classroom. This knowledge is to be read and understood by teachers and incorporated into their practice to the benefit of students who will theoretically achieve better. Fundamentally, disagreement remains about the extent to which educational research can and should contribute directly to teachers' practice.

Recent research hypothesises that, if the research-informed ambition for education is to be realised, then the development of a culture within schools conducive to teachers' continuous learning is crucial. The necessity for schools to develop a research-informed culture has possibly come to prominence following acknowledgement that, although teachers generally value the role of research-based evidence in guiding their practice, they are often intellectually unable and provided insufficient resources to make best use of it.

One might expect that teachers who more regularly engage with research would demonstrate a greater awareness of research-based knowledge. However, the empirical evidence provided within this chapter is largely contradictory with few authors reporting such a correlation. A body of philosophical literature continues to attempt to conceptualise how knowledge created through educational research is transmitted to the practice of research users. Amongst academics there is a consensus that teachers most commonly make sense of research-based knowledge through a complex and lengthy process of integrating it within their own experience-based knowledge. Problematically, that contradicts governmental ideals of teachers simply transferring research-based principles directly into their practice. Furthermore, despite government insistence that research-informed education will improve student achievement, current evidence illustrates only a weak relationship.

### 3.9 Logic Model & Research Questions

To reiterate, the purpose of the created logic model (Figure 3.1; below) is to depict the hypothesised process that knowledge created through educational research takes from its conception through to its point of impact in enhancing student achievement. Though not explicitly articulated within government literature, this path appears to reflect their assumptions for research-informed education. As illustrated throughout this chapter, each assumption within this model has some supporting philosophical and/or empirical evidence. The created model illustrates the path of this investigation and each 'step's' relationship to a corresponding RQ. The model encompasses six steps; each playing a critical role in influencing the direction of subsequent steps. Hereon, a brief justification of the relationship between each 'step' and the corresponding RQ will be offered.

**Step One: Educational research generates useful knowledge for teachers.** Chapter Two identified a political assumption that knowledge developed through educational research can be used by teachers to improve their practice (e.g., Goldacre, 2013; DfE, 2016). That agenda has fuelled the implementation of several initiatives tasked with narrowing the gap between educational research, policy, and teaching practice (e.g., EEF). Some debate remains amongst academics about the purpose of educational research and its value for teachers. However, as established in section 3.6, it is reasonable that at least some of the knowledge subsequently created is useful for teacher to use to develop their practice.

Recent attempts to measure teachers' explicit awareness of research-based knowledge (e.g., Nelson et al, 2017) may indicate acceptance that research-based knowledge can play a role in influencing teachers’ practice. Consequently, Step One accepts that educational research can create knowledge useful for enhancing teachers’ practice. Problematically, it remains unclear exactly what ‘useful’ research-based knowledge has been established, how well founded it is, and whether it has been communicated to teachers. Consequently, RQ1 will identify whether researchers have been successful in establishing a body of knowledge that is: a) useful for teachers in raising student achievement, b) consistently evidenced to be effective through robust educational research, and c) communicated to teachers.

**Step Two: Schools facilitate educational research engagement.** Once knowledge is created through educational research then it is accessed by secondary schools and the teachers within. Recent research is increasingly emphasising the importance of schools developing a ‘culture’ conducive to becoming research-informed to optimise the impact of research engagement (e.g., Coldwell et al, 2017; Brown & Greany, 2018; Cain, 2018). Much of the available research in this area has been limited to small scale case-study research therefore there remains a lack of robust evidence. RQ2 will contribute towards this gap in literature by using Cain’s (2018) framework to identify the extent to which a broad range of secondary schools are progressing towards developing a research-informed culture.

**Step Three: Teachers engage with educational research.** Several earlier authors (e.g., Maggs & White, 1982) reported that teachers are unenthusiastic about the prospect of using research to inform their practice. More recent research tends to illustrate that teachers’ dispositions towards the usefulness of research are more positive (e.g., Coldwell et al, 2017; Nelson et al, 2017), however, there remains some evidence that teachers’ dispositions are indifferent (e.g., Gore & Gitlin, 2004). The empirical literature discussed (e.g., Everton et al, 2002; Beycioglu et al, 2010) highlights several common: a) methods utilised by teachers to engage with educational research (i.e., CPD, post-graduate study, online platforms (e.g., EEF)), and b) limitations that teachers face in becoming research-informed (i.e., physical and intellectual inaccessibility).

RQ3 will develop this area of literature by: a) providing confirmatory evidence for aspects with more consistent evidence (e.g., obstacles teachers face), and b) further exploring aspects with less consistent findings (e.g., teacher dispositions about the usefulness of using research to guide practice). This data will also facilitate exploration of a relationship between teachers' value for educational research and their awareness of well-established educational research findings. Some prior literature has touched upon developing a link but either: a) in a highly-specific context which differs from this investigation (e.g., Piasta et al, 2020) or b) using a limited selection of reportedly well-established educational research findings (e.g., Nelson et al, 2017).

**Step Four: Educational research engagement enhances teachers' knowledge.** Until recently, research exploring teachers' awareness of research findings was limited to neuromyths (e.g., Howard-Jones et al, 2009; Dekker et al, 2012) and quite consistently reported that teachers subscribe to them. Piasta et al (2020) and Nelson et al (2017) are the only known identified investigations to measure teachers' objective awareness of well-established educational research findings and both have important limitations, hence the significance of RQ4 in contributing to current literature. Here, the regularity with which teachers can identify both neuromyths and teaching principles which are well-established to raise student achievement through robust educational research will be identified.

**Step Five: Teachers use educational research to guide their practice.** For research-based knowledge to influence teachers' practice and subsequently student achievement, then teachers must 'use' knowledge acquired through educational research in some way. As identified by Cain (2016a; 2016b) and to be discussed in Chapter Four, teachers tend to use knowledge acquired through educational research in conjunction with other forms of knowledge (e.g., tacit) in guiding their practice but the process is notoriously complex (Cain et al, 2019). Acknowledgement of this step in the created logic model is crucial because the way teachers use research-based knowledge will undoubtedly influence the subsequent impact on their practice. Though this investigation will take relatively small steps towards addressing this uncertainty, they are considered insufficient to warrant inclusion as a RQ.

**Step Six: Being research-informed positively influences student achievement.** Despite political and (some) academic support for the proposition that being research-informed will improve student achievement, recent research (e.g., Huat See et al, 2016; Rose et al, 2017) has provided only weak evidence of a relationship. RQ5 is perhaps the most significant aspect of this investigation because it has potential implications for academics, SMT, and policy-makers. RQ5 will attempt to identify a relationship between the following three variables: a) the extent to which school's have developed a research-informed culture, b) teachers' objective awareness of well-established educational research findings, c) teachers' dispositions towards the usefulness of research for guiding practice, and d) student achievement within the respective schools.

Figure 3.1. Logic Model with corresponding RQs

| | |
|---|---|
| Step 1: Educational research generates useful knowledge for teachers | RQ1: Has educational research created a robust body of knowledge that is relevant for teachers' practice? |
| Step 2: Schools facilitate educational research engagement | RQ2: To what extent are the teaching cultures of secondary schools research-informed? |
| Step 3: Teachers engage with educational research | RQ3: What perceptions do teachers hold about the usefulness of using educational research to guide practice? |
| Step 4: Educational research engagement enhances teachers' knowledge | RQ4: To what extent are teachers aware of well-established educational research-based findings? |
| Step 5: Teachers use educational research to guide their practice | |
| Step 6: Being research-informed positively influences student achievement | RQ5: What is the relationship between: a) the research-informed teaching cultures of secondary schools, b) teachers' awareness of well-established educational research findings, c) teachers' perceptions about research usefulness, and d) student achievement? |

# Chapter Four: Theoretical Framework

## 4.1 Introduction

An underlying proposition throughout this investigation is that teachers' practice and subsequently student achievement will be enhanced if teachers 'are knowledgeable about educational practices that have proven records of accomplishment' (Cochran-Smith & Lytle, 1999; pp. 259) and sceptical about those that do not. The preceding chapter served to provide evidence that research-based knowledge is accessed by teachers, can be relevant to, and enhance their practice leading to a positive influence on student achievement.

Section 3.6 provided an introduction into the processes that teachers might navigate in using research-based knowledge to guide their practice, however, our understanding remains incomplete (Cain, 2018; Winch et al, 2015). To better understand those mechanisms, this chapter will predominantly explore the types of knowledge that teachers use in their practice and tentatively make sense of the (somewhat fragmented) body of literature deliberating how research-based knowledge can contribute to, and supplement, those knowledge-types.

Prior to that, the assumption made thus far throughout this thesis about a positive relationship between teaching practice and student achievement will be explored. The importance of teaching practice quality in determining student achievement has received substantial attention and the DfE (2010; p. 9) seem confident of its significance, stating that 'all the evidence from different education systems around the world shows that the most important factor in determining how well children do is the quality of teaching'. Stronge, Ward, Tucker, and Hindman (2007) provide some supporting evidence based on a sample of 1936 primary school-aged students taught by 85 teachers across one school district in the USA. Using standardised assessments in English, maths, social studies, and sciences, the achievement of those students was compared against expected achievement to provide 'an indicator of teacher effectiveness' (p. 165). The assumption that effective teachers foster achievement gains beyond that expected broadly aligns with value-added accountability systems applied to teachers and schools within

England. Participating teachers were each responsible for teaching their class all subjects under investigation.

Difference scores in achievement for students were standardised and averaged to calculate a score for the respective teacher. After controlling for extraneous variables (e.g., absences, prior achievement, socio-economic status), the distribution of scores attributed to each teacher enabled identification of most and least effective. The practice of the five most effective teachers was compared to that of the six least effective teachers by observers who assessed each teacher on several occasions during their practice against 20 categories within the following domains: instruction, student assessment, classroom management, and personal qualities. A double-blind was implemented; teachers were not informed why they were being observed and the observers were not informed which teachers were considered effective or ineffective. The teachers originally considered more effective scored higher across each domain. Notably, analyses in Stronge et al's (2007) investigation 'focused on trends of the findings rather than statistical analyses' (p. 181) reportedly due to the large number of variables accounted for and limited sample of teachers.

## 4.2 Knowledge Teachers Use to Guide Practice

This section will be used to describe the knowledge-types which, according to Winch et al (2015), philosophers broadly agree both guide teachers' practice and reflect facets of knowledge that effective teachers possess: situated understanding, technical knowledge, and critical reflection. For Wieser (2016), the former two knowledge-types are practical knowledge and the latter is personal knowledge. Beyond the knowledge-types cited by Winch et al (2015), Schulman (1987) discusses how formal knowledge retrieved from a teacher's respective subject specialism or sourced from educational documentation and structures (e.g., curricula, awarding bodies) may also influence teachers' practice. Without disputing the role of the knowledge-types discussed by Schulman (1987), they are beyond the remit of this investigation and will therefore be excluded from subsequent discussion. This investigation is generally limited to exploring the role of research-based knowledge in contributing to, and/or supplementing the three knowledge-types discussed at the outset of this paragraph.

**4.2.1 Situated understanding.** Winch et al (2015) describe situated knowledge as a form of tacit knowledge (or 'practical wisdom' (Shulman, 1987)) that teachers develop through experience, use intuitively in their practice, but notoriously find difficult to articulate. Winch et al's (2015) conceptualisation of situated understanding shares similarities with the concept of 'know-how' developed by Ryle (1949, as cited in Winch et al, 2015). Cochran-Smith and Lytle (1999; p. 259) attribute difficulty articulating situated understanding to a struggle separating 'knowledge from the knower'. More specifically, Kratka (2015; p. 838) explain that tacit knowledge is personal, inextricably connected between person and a context; it is 'deeply rooted in a person's actions, experience, thoughts and values'. Acceptance of situated understanding as a useful knowledge-type in guiding teachers' practice is evident through consistent appearance in philosophical literature.

Teachers who have developed a situated understanding are said to be better able to negotiate complex classroom situations effectively in the absence of clear solutions (Leindhart, 1990). On a similar note, Winch et al (2015; p. 205) contend that teachers demonstrate situated understanding through their ability to use features of a learning situation to 'deliberate imaginatively and holistically, and to make practically sound judgments'.

**4.2.2 Technical knowledge**. Derived from the term 'techne' coined by Aristotle, technical knowledge refers to one's ability to engineer a desired situation within a setting (Winch et al, 2015). Technical knowledge is considered more sophisticated than simply the ability to follow and perform a specific set of instructions. For Dunne (1993, p. 9), teachers demonstrate technical knowledge when their practice entails 'a clear conception of the why and wherefore, the how and with-what of the making process' necessary to facilitate student progress. Unlike situated understanding, Hordern and Tatto (2018) claim that teachers can articulate technical knowledge and provide the following scenarios where technical knowledge may be observable: a) explaining appropriate procedures to meet particular goals in the classroom, and b) explaining the effectiveness of an intervention and the contextual circumstances in which the given intervention is likely to be effective.

**4.2.3 Critical reflection.** Winch et al (2015) summarise the literature surrounding teachers' critical reflection into three facets: reflection-in-action, reflecting as a scholarly activity, and systematic enquiry. Schön (1983) conceived reflection-in-action to describe an introspective, iterative cycle of practice and reflection within the classroom environment. Boyer's (1990) interpretation of reflection as a scholarly activity places focus on the influence of implicit and explicit discourse which teachers consume and interpret in a way that aligns with other knowledge-types they possess. Several authors (e.g., Libak & Tinsley, 2010) have highlighted how teachers can also enrich their critical reflection by conducting independent systematic enquiry (e.g., action research) focusing on a 'problem' within their practice. The value of teacher-research remains popular within practitioner texts and ITT programmes. However, in Schön's (1983) original conception, research-based knowledge did not necessarily play an influential role because it is based on a teacher's own actions within the classroom.

## 4.3 Contribution of Research-Based Knowledge.

Knowledge derived from educational research provides an additional source from which teachers can draw to inform their practice. To varying extents, many philosophers are cautious about the value of research-based knowledge in guiding teaching practice (e.g., Biesta, 2010, 2012; Hammersley, 2008) and there are several reasons why. For example, despite ultimately advocating the influence of research-based knowledge on teachers' practice, Winch et al (2015; p. 202) discuss the perspective that educational research cannot contribute to teaching practice because 'both research and teaching are historically-informed practices steeped in contextual contingencies'. Wrigley (2018) highlights concern that over-emphasising the value of research-based knowledge, whilst ostensibly empowering, may serve to 'blinker' teachers and undermine their autonomy.

Despite such apprehensions, the majority (e.g., Wieser, 2016; Cochran-Smith & Lytle, 1999; Shulman, 1987; Winch et al, 2015; McIntyre, 2006) maintain that research-based knowledge can, and should, influence teaching practice. For McIntyre (2006; p. 360) research-based knowledge cannot directly influence teachers' practice because it is a 'sharply contrasting kind of knowledge' to those mentioned in section 4.2 because it 'must be formulated in generalised terms, whereas classroom teaching is necessarily and very fundamentally personalised'. Leinhardt (1990) reinforces that, arguing that knowledge teachers directly draw upon to guide their practice must, above all, be useful in addressing context-specific classroom characteristics (e.g., unique teacher-student relationships). The production and value of different types of knowledge between teachers and researchers should probably be of little surprise because, as noted by McIntyre (2006), the disciplines require different thinking. He rightly argues that research is adjudged by methodological rigour and rational argument whereas teachers must make fluid decisions in classrooms which 'depend on tacit thinking rather than on the rigour of underlying arguments' (McIntyre, 2006; p. 360).

For Cochran-Smith and Lytle (1999) and Gardner's (1989; p. x), research-based knowledge (or 'knowledge-for-practice') is a distinctive knowledge-base that 'when mastered, will provide teachers with a unique fund of knowledge that is not pedestrian or held by people generally'. Perhaps reflective of a societal 'fundamental faith in scientific knowledge as a source of expertise' (Donmoyer, 1996; p. 98), Biesta (2010; p. 494) states that some consider research-based knowledge unique in that it is 'true knowledge... an accurate representation of how 'things' are in the world' Biesta (2010, p. 494). Based on the findings of Borg (2009) (discussed in section 3.4.1), Biesta's (2010) statement would more likely hold true from the perspective of teachers only for research conducted using traditional quantitative scientific methods.

Indeed, teacher training programmes have historically been based on the premise that those who 'know more' will provide more effective teaching practice (Cochran-Smith & Lytle, 1999). Past and current initiatives created to facilitate research-informed education (see Chapter Two) suggest that 'knowing more' about educational research is still considered by policy-makers crucial in developing effective teachers. However, reflecting the DfE (2014) directive for research-informed education, Winch et al (2015; p. 204) acknowledge that research cannot prescribe practices to teachers and instead argue that all research findings should ‘be mediated by the demands of particular pupils, classrooms or curricula, and re-contextualised within a particular school’s normative environment’.

Beyond the role of educational research-based knowledge in influencing teachers’ practice, this investigation also considers the prospect and implications of teachers using ‘false’ knowledge derived from neuroscience (i.e., neuromyths). For Winch et al (2015; p. 211) teachers’ exposure to false knowledge is important in ‘sharpening their critical interpretation of research evidence’. Neuromyths can often be traced back to misread, misconstrued, or exaggerated educational neuroscience findings transferred into teaching practice (Dündar & Gündüz, 2016). Although false knowledge encountered by teachers is not exclusively sourced from educational neuroscience, this investigation is limited to exploring the extent to which teachers subscribe to that in the form of neuromyths. Fuson (2009) discusses how misinterpretations of powerful figures in education such as Vygotsky and Piaget have also led to occasions of teacher ‘practices that are counterproductive for children’ (p. 343).

For Gabrieli (2016), there is growing interest in the application of neuroscience research findings into teaching practice. Evidence of that can be seen through recently established journals (e.g., Trends in Neuroscience and Education) and research centres (e.g., Cambridge Centre for Neuroscience in Education), as well as suggestion that neuroscience could be a ‘tool for science-based education policy, which can help assess the performance and impact of different educational approaches’ (Royal Society, 2011; p. 9). For Bowers (2016; p. 600), ‘the most fundamental claim associated with educational neuroscience is that new insights about the brain can improve classroom teaching’ and ‘teachers should play a central role by adopting these new teaching methods in their classrooms’.

There are some within academia (e.g., Carew & Magsamen, 2010; Goswami, 2008) who subscribe to the promise of educational neuroscience for influencing teachers’ practice but, perhaps consequent to several criticisms against the prospect (see Bowers (2016) for a comprehensive discussion) there are an increasing number of critics (e.g., Geake, 2008; Bowers, 2016; Macdonald et al, 2017). Arguably the most pertinent of those being Bowers' (2016; p. 601) observation that: a) 'there are no examples of neuroscience motivating new teaching methods that are effective', and b) educational neuroscience has failed to produce any knowledge that could, or has, not been derived from behavioural research.

Geake (2008) and The Wellcome Trust (2014) provide evidence of teachers utilising practices driven by neuromyths. For example, despite being debunked, Geake (2008) and, Pashler, McDaniel, Rohrer, and Bjork (2008) report that teachers continue to subscribe to the proposition that student achievement can be improved by aligning teaching strategies with students' preferred learning styles. Geake (2008; p. 125) argues that as is the case for most neuromyths, there may be a 'glimmer of truth [as] usually their origins do lie in valid scientific research' but the problem lies in 'the extrapolations which go well beyond the data, especially in transfer out of the laboratory and into the classroom'. In the case of VAK learning styles, Geake (2008) argues that individual differences in perceptual differences exist but 'that does not mean learning is restricted to, or even necessarily associated with, one's superior sense' (p. 126).

### 4.4 Making Research-Based Knowledge Usable for Teaching Practice

To begin, it is worth acknowledging that there is some debate about the role that teachers can and should play in transforming research-based knowledge into that which can contribute to teaching practice. For example, Winch et al (2015; p. 209) suggest that such a task should be within the remit of 'educational technologists and curriculum designers'. This investigation rejects that proposition, instead consenting to the majority within academia (e.g., Cain, 2018) who argue that teachers can and perhaps must be the agents to process and transform research-based knowledge into that which is usable in their practice. As alluded to in section 3.6, uncertainty remains about mechanisms through which teachers can transform research-based knowledge into that which can enhance their practice (Wieser, 2016). Perhaps consequently, Winch et al (2015) promote using research to explore interactions between knowledge-types rather than for the 'what works' agenda of identifying effective teaching practices.

Cain (2015a, 2015b) and Brown (2017) illustrate that teachers transfer research-based knowledge to the classroom by assimilating it other types of knowledge they possess (Cain, 2015a; Cain, 2015b). For Brown (2017; p. 389), those assimilations result in the development of 'expertise in their [teachers] application, beginning to understand how, where and why' use of educational research is likely to be most effective. Brown's (2017) conclusions are based on research involving 16 teachers from eight schools within a teaching school alliance RLC. Teaching schools are tasked with engaging partnering schools in research activity therefore, as Brown (2017) acknowledges, caution should be taken in generalising findings. Participants attended four workshops through one academic year. The first workshop entailed 'understanding the research and current practitioner-held knowledge about the specific issues being explored' (p. 393). In workshop two, a research-informed approach to improving an aspect of practice was created and discussions took place about how to implement it. Workshops three and four involved participants refining the research-informed approach and discussing ways to distribute the knowledge more widely. Following workshop four, participants completed 'knowledge creation' activities designed to combine teachers' tacit knowledge with research-based knowledge. Participants then answered three questions to identify the extent to which they agreed that RLC's helped them to better understand, and make sense of, research-based knowledge in conjunction with other knowledge. All participants reported either agreeing or strongly agreeing with each question.

As outlined in section 3.6, the most commonly cited framework for understanding teachers' use of research centres on 'instrumental', 'conceptual' or 'symbolic' use (e.g. Ion & Iucu, 2014), however, Cain (2018) and Cain et al (2019) cite several flaws commonly lodged against it. The instrumental approach has been criticised for being simplistic (e.g., Cain, 2016b) perhaps following 'limited evidence … of teachers directly importing research findings to change their practice (Coldwell et al, 2017; p. ix). Strategic research use is critiqued because it may imply superficial engagement and cynical use to further a particular agenda (Cain & Allan, 2017). Indeed, only conceptual research use appears to have some empirical and philosophical research support (e.g., Huat See et al, 2016; Coldwell et al, 2017; Cain, 2015b). Perhaps consequently, researchers are exploring contemporary frameworks to explain how research-based knowledge can influence teaching practice indirectly. Two such frameworks have been proposed by Winch et al (2015) and Cain (2018). The former will be discussed briefly before Cain's (2018) occupies the remainder of this chapter.

Winch et al (2015) discuss teaching practice 'as a professional endeavour', which involves making 'sound judgements' in practice using the three knowledge-types discussed earlier (i.e., critical reflections, technical knowledge, situated understanding) in conjunction with an assessment about 'whether, when, and how research-based considerations are relevant' (Winch et al, 2015; p. 210). They theorise that, depending on the outcome of that assessment, research-based knowledge can supplement each of those knowledge-types. For example, it can enhance the richness of teachers' critical reflections by 'challenging and authenticating their unfolding understanding of the situation in which they find themselves' (p. 210). In other words, through critical reflection the usefulness of research-based knowledge can be somewhat (in)validated by the values and norms within that individual's professional context. Research-based knowledge can also proposedly improve teachers' technical knowledge by providing a 'practical toolbox' consisting of robust and universal evidence about the usefulness of strategies and interventions whilst also offering clear guidance about how and when to most effectively implement them. Teachers must then exercise discretion and judgement in refining and evaluating research-based knowledge by mediating it against 'the demands of particular pupils, classrooms or curricula, and re-contextualising it within a particular school... environment' (Winch et al, 2015; p. 211). In short, the argument is that effective teaching practice involves teachers engaging with educational research to create an iterative 'research-teaching relationship' which can contribute to the 'irreducibly craft-based elements' (p. 211) of teaching practice.

Although Cain (2018) agrees that research-based knowledge can enhance teaching practice indirectly, there are some differences in how he frames the relationship. Cain (2018) agrees that research-based knowledge can enhance teachers' reflections, however, he also argues that it can enhance their decision-making.

**4.4.1 Improves teachers' decision-making.** That proposition aligns with the perspective of some research-informed education advocates and the What Works agenda which stipulates that 'good decision-making should be informed by the best available evidence' (Cabinet Office, 2013). For example, Goldacre (2013; p.7) stated that 'we all expect doctors to be able to make informed decisions about which treatment is best, using the best currently available evidence. I think teachers could one day be in the same position'. Problematically, some perspectives (e.g., advocates of research-based education) seem to assume that teachers' decision-making is straightforward and can be based on one form of knowledge, ideally that which is research-based. As Hammersley (2005) argues, such perspectives are reminiscent of the discredited instrumental model of research utilisation.

Cain (2018) and Cain et al (2019) frame decision-making as a complex process were actions result from negotiation between several sources of knowledge (including that which is research-based). As a starting point, research-informed decisions may be considered as actions made following deliberations with one or more forms of evidence which may include research-based knowledge, professional assumptions and, what Winch et al (2015) describe as situated understanding. However, as discussed by Cain et al (2019), this view of decision-making is incomplete because evidence rarely points to a clear outcome because other variables play a role in determining the resultant outcome (or action). For example, assumptions will be assigned to data encountered which will influence the weight subsequently attributed to it in the decision-making process. That picture is further complicated as that process is multiplied with each form of evidence encountered.

Cain (2018) and Cain et al (2019) differentiate between flawed quick-fire decisions that teachers predominantly make in the classroom and more thoroughly rationalised decisions which are made about practice but considered outside of the classroom (e.g., planning teaching strategies). Quick-fire decision-making shares some characteristics with Schön's (1983) conception of reflection-in-action and cannot be directly influenced by research-based knowledge (Cain et al, 2019). An example of quick-fire decision-making would include the management of student behaviour issues. Cain et al (2019) argue that common flaws in teaching practice may be attributable to 'the weaknesses of fast thinking' (p. 1079); providing examples of teachers' excessively weighting evidence that supports existing beliefs and regular over-estimate of student knowledge to support their Howeverargument., The role of research in fast decision-making is not to directly influence decisions which happen in the classroom. Instead, it is argued that it is to enable teachers to improve their thinking and acting more generally and that can happen by enhancing their critical reflection (to be discussed further in section 4.4.2).

More commonly, research-based knowledge influences 'slow', 'habitual thinking and acting' (Cain, 2018; p. 36) which form a thinking platform upon which future teaching decisions are made. Evidencing his theory, Cain (2018) points to a case-study of a primary school in England in which research-based knowledge was used to influence an intervention to enhance parental involvement in their children's education. Coldwell et al (2017; p. 7) provides some further support highlighting that research engagement often 'informed their thinking and led … to experimenting, testing out and trialling new approaches'. The impact of research-based knowledge even in decisions involving slow thinking is not necessarily straightforward. Using the concept of 'optimal rationality', Brown and Zhang (2016) explain that teachers' decision-making also incorporates perceived potential implications in terms of people's (e.g., teachers') values, traditions and beliefs also influence such decisions.

**4.4.2 Enhances teachers' reflections.** To reiterate, Cain (2018) and Cain et al (2019) concur with Winch et al (2015) that research-based knowledge can influence the critical reflection which teachers undertake outside the classroom (i.e., reflection-on-action (Schön, 1983)). However, unlike Winch et al (2015), he proposes that teaching practice is subsequently improved because research-informed reflections challenge and develop teachers' mindsets (i.e., 'organic, holistic way of looking at teaching' (Cain, 2018; p. 39)) which underpin the fast decisions teachers make in the classroom. Within Cain's (2018; p. 34) theory, research-based knowledge can help ensure that teachers' reflections refrain from being 'insular and inward-looking' and instead promotes more effective 'patterns of thinking'. Touching on a similar point, Cain et al (2019) argue that research can influence the conceptual frameworks that teachers hold, which are usually formed by their previous classroom experiences and problems they navigate within professional contexts. The 'conceptual frameworks' referred to above have their teaching have been described using a variety of terms in earlier literature (e.g., 'habits of mind' (Dewey, 1933; as cited in Cain et al, 2019)) which speaks to the complexity of the phenomena in discussion. Both terms refer to mental frameworks which include and combine cognitive and emotive structures which teachers hold about education (e.g., 'teachers' knowledge of students, their beliefs and values, and their sense of identity and mission' (Cain et al, 2019; p. 1080).

Evidencing this theory, Cain (2018) points to his earlier research (Cain, 2015a; Cain, 2015b) discussed in section 3.4.3. There, interview data revealed that research provided to teachers to better equip them to challenge G&T learners influenced their thinking during planning. Ultimately, the types of tasks planned for G&T learners during lessons changed from those which facilitated students with more practice to those requiring higher-level thinking. For one teacher, those changes were a consequence of research-based knowledge making her "reflect a lot on something I wouldn't have spent a lot of time thinking about" (Cain, 2015a).

Cain et al (2019) argue that research can influence teachers' thinking through a process of reflection in two ways; what they think about and how they think about it. To provide some examples, research can provide supplementary detail to the concepts already usually employed by teachers and thereby serve to develop them. Research can also serve to steer teachers' inquiry within their own practice by 'challenging their established ways of thinking and acting' (Cain et al, 2019; p. 1081). That can subsequently result in several positive actions including a willingness to experiment with new ideas and a critically enhanced view of evidence of student learning.

## 4.5 Summary

To summarise, this investigation proposes that teachers draw on several different types of knowledge (i.e., situated understanding, technical knowledge, critical reflection) in their endeavour to provide effective teaching practice, each of which can be enriched by a strong awareness of research-based knowledge. It is not being suggested that research-based knowledge can, or should, supersede other knowledge-types. Instead, in line with the proposition put forward by Winch et al (2015), an approach whereby research-based knowledge can support and complement other knowledge banks is endorsed. As highlighted, while research-based knowledge is considered undoubtedly useful in promoting effective teaching practice by providing evidence to support particular ‘tools’, such knowledge should be mediated by unique personal professional, and institutional values as well as cohort- and curricula-specific characteristics.

## Chapter Five: Research Methodology & Methods

This chapter will use the following subheadings to describe and justify the research strategy employed for this investigation:

- Research Philosophy
- Research Approaches & Methods
- Instruments
- Sampling
- Procedure
- Ethical Considerations
- Analytic Strategy

### 5.1 Research Philosophy

Describing the adopted research philosophy is important because it represents 'the basic belief system or world view that guides the investigation, not only in choices of method but in ontologically and epistemologically fundamental ways' (Guba & Lincoln, 1994; p. 105). As promoted by Hanley et al (2016) and utilised in some similar literature (e.g., Nelson et al, 2017), this study adopted a pragmatic philosophy which Kalolo (2015) describes as an action-oriented approach to finding solutions for existing problems. The existing problems in focus have been explored in Chapter Three but essentially centre on:

- Government perspective that student achievement can be raised through research-informed practice despite little supporting evidence
- Concern that educational research cannot provide teachers with useful and robust knowledge
- Inconsistency in the value that teachers place on educational research findings as a tool for enhancing practice

For Biesta and Burbules (2003), pragmatism emerged principally from the work of Charles Sanders Peirce (1839 - 1914), William James (1842 - 1910), and John Dewey (1859 - 1952) and occupied only a marginal position in philosophical debate before growing in influence over the past couple of decades. There are various conceptions of pragmatism which cover several philosophical topics beyond logic and methodology (e.g., ethics, politics) and there are some fundamental differences in the ideas of pragmatists (Kalolo, 2015). Pragmatism has historically been linked with mixed methods research but, according to Morgan (2014), the two are not necessarily connected. For Biesta and Burbules (2003) pragmatism is not prescriptive; it does not insist upon a specific strategy or particular methods for conducting research. Pragmatism can reportedly serve as a philosophical stance for stand-alone quantitative or qualitative methods because it replaces 'older philosophies of knowledge which understand research in terms of ontology, epistemology, and methodology' with a working, critical perspective about the possibilities and limitations of educational research (Morgan, 2014; p. 1050).

Pragmatism carries values of practicality and a goal-orientation in dealing with research problems, both of which were necessary considerations in safeguarding the value of this investigation. Amongst other reasons, a goal-orientation was important because this investigation was planned with a key aim of generating evidence about the effectiveness of research-informed education which could potentially be used to inform policy and research. As illustrated in the created logic model (see section 3.9), each RQ was strategically developed to: a) contribute to solving educational policy- and/or practice-based problems, and b) capture a dimension which, according to the relevant literature, can influence the success of a research-informed approach to education in raising student achievement.

That approach to generating RQs was adopted as it facilitated this investigation's exploratory attempt to simplify and capture the complex trajectory of research-based knowledge from its conception to point of impact in raising student achievement. An exploratory approach was necessary because there appears to be an absence of literature attempting to follow and capture the process described in the created logic model in its entirety. A pragmatic research philosophy also facilitated the use of research methods based on those perceived to be most effective in responding to the generated RQ's. In doing so, the intention was to obtain evidence for or against the research-informed ambition for education which could influence further research and policy in this field.

Badley (2003; pp. 301) also promotes a pragmatic approach to research design, arguing that it can alleviate the ‘main [methodological] causes of crisis in educational research’. The concerns cited by Badley (2003) to be discussed have since been reiterated by Kalolo (2015). The first challenge, ‘false certainty’, is largely aimed at traditional concepts of positivism and, as touched upon in section 3.2, accuses policy-makers of neglecting complexities within education and retreating to dominant philosophical positions. Despite teaching practice becoming increasingly complicated and uncertain due to factors such as increased teacher accountability and multi-culturalism, policy-makers continue to promote research methodologies which target ‘certainty’. Problematically, single-dimensional constructs ‘present a limited measure that fails to meet the current requirements of highly complex educational systems’ (Kalolo, 2015; p. 151). In contrast, multi-dimensional approaches can maximise the richness and quality of research outcomes. A multi-dimensional approach in this investigation enabled identification and utilisation of research methods considered most useful for tackling each respective RQ. To further promote the richness of data collected, the perspectives of different agents’ (i.e., teachers, SMT) about the research-informed education drive were explored.

The second problem highlighted by Badley (2003) and Kalolo (2015), referred to as ‘false dualism’, is described as the gap between positivism and constructivism with proponents of the former arguing for an objective reality and those of the latter favouring socially constructed realities. For Hall (2013) and Tashakkori and Teddlie (2003, p. 713), pragmatism ‘sidesteps the contentious issues of truth and reality’ by ‘focusing instead on what works for the research questions under investigation’ and rejecting the necessity to locate itself between opposing viewpoints. Aligning with those perspectives, this investigation did not favour or hold in higher esteem any particular paradigm but instead created a research strategy to most effectively make sense of complex phenomena and facilitate informative research outcomes. This is demonstrated by the range of research approaches (to be discussed in the next section) used throughout this investigation.

It may be argued that the adopted epistemological position within this investigation varies between RQs and, perhaps on that basis, this thesis could be considered as a series of individual investigations. That is not considered problematic based on the justifications already discussed for creating RQs and adopting research methods based on their perceived usefulness. To provide an example, RQ1 entailed exploration of educational research to identify teaching principles which are well-established in raising student achievement. The approach taken to answering this RQ accepts that research is capable of: a) objectively capturing knowledge that stands true largely regardless of context or interpretation, and b) providing knowledge that can be known by teachers in a way that is objective and distinct from that constructed through experience, dialogue, or reflection. In contrast, RQ5 was developed to identify a relationship between being research-informed and student achievement. Here the scope and possibilities of research in providing a 'true' and complete representation of the real-world are more reserved.

Badley's (2003) description of the third problem, 'false expectations' largely centres on concern that the current government are 'inappropriately' (Hammersley, 2005; p. 319) over-extending the scope of large-scale, quantitative research in guiding educational practice. Hammersley's (2005) argument largely aligns with the perspective of some pragmatists who contend that the governmental perspective 'may not be the most useful approach to the particularly open and indeterminate world of education' (Badley, 2003; p. 305). The findings of this investigation will provide evidence for or against concerns, such as those put forward by Hammersley (2005), that the application of research-based knowledge acquired through large-scale quantitative research is being extrapolated beyond its means (i.e., over-extended) by government directives.

## 5.2 Research Approaches and Methods

A multimethod research strategy was adopted for this investigation simply because a mono-method research strategy would not have been appropriate for each formulated RQ. Within the literature there remains disagreement about the definition of multimethod research; some authors (e.g., Teddie & Tashakkori, 2003) reserve the label for research incorporating both quantitative and qualitative methods. However, befitting this investigation, multimethod research is 'broadly defined' by Anguera et al (2018; p. 2760) as 'the practice of employing two or more different methods or styles of research within the same study or research program'. Anguera et al's (2018) definition more closely aligns with the majority in academia; for example, Hunter and Brewer (2003; p. 580) define it as 'the use of multiple methods with complementary strengths and different weaknesses in relation to a given set of research problems'. The different methods utilised throughout this investigation are described and justified below.

**5.2.1 RQ1: Has educational research created a robust body of knowledge that is relevant for teachers' practice?** The purpose of this RQ was to identify whether educational researchers have successfully developed a bank of knowledge that is: a) useful for teachers to use in guiding their practice, and b) communicated to them in a way that is physically and intellectually accessible. Elaborating on the former, the 'useful' knowledge sought was that which is research-based knowledge in the form of teaching principles which are well-established through robust research in raising student achievement. A two-stage process was created to meet the objectives set out at the start of this paragraph. The process will be introduced briefly here but the following chapter is dedicated to discussing both the process and findings.

Stage One consisted of a review of practitioner texts which met instated criteria to identify teaching principles which are communicated as being effective in raising student achievement. Once a selection of teaching principle had been identified, Stage Two commenced in which a review was conducted across individual investigations underpinning those principles to ensure that they: a) qualify as being research-based, and b) are based on methodologically robust research. Within the following chapter, definitions of key terms and qualifiers (e.g., 'robust') are provided, along with imposed criteria and corresponding justifications. Once teaching principles which met all instated criteria were identified, they were included into the survey used to tackle RQs 3 & 4.

The approach taken to answering RQ1 largely resembles a literature review; that is a 'comprehensive study and interpretation of literature that addresses a specific topic' (Cohen, Manion, & Morrison, 2011; p. 82). Utilising a literature review enabled identification of teaching principles in a thorough, systematic, critical way by facilitating inclusion of various criteria and parameters. Inclusion of those qualifiers (i.e., criteria and parameters) was particularly important given the growing number of practitioner texts being published and concern about lacking methodological robustness of some educational research. McMillan (2012) reinforce the decision to use a literature review, promoting their strength for: a) identifying and summarising sources within a bank of literature, and b) evaluating methodological quality.

A literature review also facilitated exploration of the similarity with which researchers have defined and conceptualised teaching principles. This was important in ensuring that accessed investigations were studing highly similar concepts. The literature review conducted is not claimed to be exhaustive; it was not possible to be sure that all practitioner texts and individual investigations which met the instated criteria were accessed. However, in accordance with the pragmatic approach adopted, the literature review was sufficiently thorough to ensure that principles were well-established and communicated to teachers.

**5.2.2 RQ2: To what extent are the teaching cultures of secondary schools research-informed?** RQ2 was addressed using a survey distributed to the person(s) responsible for developing teachers' CPD in each participating school. Hereon, this survey will be referred to as the 'School Survey' (Appendix 1). The person responsible for teachers' CPD was targeted because they were considered to be well-placed to discuss steps taken by that particular school in: a) utilising research-based knowledge, b) facilitating teachers' research engagement, and c) encouraging teachers to maintain currency with research.

Cain's (2018) framework for developing a research-informed culture (discussed in section 3.3) was used to guide the investigation of RQ2. Owing to the recency of his framework, it was necessary to construct a survey as one not was not pre-existing. The created survey will be discussed at greater length in section 5.3.1 but briefly it consisted of 15 items of various formats, each item was formulated to capture and measure a construct of Cain's (2018) framework. To provide a reminder, Cain's (2018) framework sets out both: a) the necessary structures (i.e., distributed leadership, support for individuals, support for groups, whole staff involvement, and partnerships with external bodies) for schools to develop a research-informed culture, and b) the ways in which research-based knowledge can contribute to enhancing teaching practice (i.e., informing teachers' decision-making, challenging teachers' mindsets, and developing schools as intelligent communities). To provide an example of how this was operationalised; participants were provided with a list of possible responses and asked the following multiple-response question to identify how schools provide 'support for individuals' in engaging with research and therefore 'inform teachers' decision-making': 'To support teachers in using research, our school provides (tick all that apply)'.

**5.2.3 RQ3: What perceptions do teachers hold about the usefulness of using educational research to guide practice? RQ4: To what extent are teachers aware of well-established, educational research-based findings?** These RQs have been grouped because they were addressed using a single instrument, hereon referred to as the 'Teacher Survey' (Appendix 2). Teacher Survey: Section One was designed to address RQ3 and Teacher Survey: Section Two to tackle RQ4, each will be discussed in-turn.

**5.2.3.1** ***Teacher Survey: Section One.*** As discussed in section 3.4, there is a raft of research investigating the value teachers place on education research findings for guiding practice. Though much of that research utilised surveys, it was necessary to create a survey here for two reasons. Firstly, many of those utilised previously (e.g., Beycioglu et al, 2010) were created for teachers in highly different contexts and there is little evidence that existing instruments would not bias samples with potentially confounding characteristics (e.g., nationality). When this investigation was designed, instruments created for similar samples to those recruited here were created almost 20 years ago (e.g., Everton et al, 2002). Given the pace of developments within both research and policy in this field, it was necessary to develop an instrument capable of capturing contemporary nuances that determine teachers' perceptions.

Teacher Survey: Section One consisted of nine items (plus sub-items). Alike the School Survey, a variety of multiple-, free-response, and rank formats item formats were used. Item format was driven by their perceived usefulness in exploring the RQ whilst also gathering data that would facilitate the analytic strategy (see section 5.7).

**5.2.3.2** ***Teacher Survey: Section Two.*** Levin et al (2011), Nelson et al (2017), Boser (2019), and Howard-Jones et al (2009) have each previously created instruments consisting of items based on different types of research-based knowledge. Levin et al's (2011) instrument consists solely of well-established educational research findings, Howard-Jones et al's (2009) was made up of neuromyths, and those created by Nelson et al (2017) and Boser (2019) consisted of both. Several reasons why those surveys could not be used will be discussed.

Instruments created by Levin et al (2011) and Boser (2019) were not appropriate because they were constructed to identify whether participants *agreed* with well-established research findings, whereas this investigation sought to identify teachers' *awareness* of them. Furthermore, the research findings used by Levin et al (2011) were based on research conducted in Canada relating to 'student pathways and trajectories' (Levin, Cooper, & Mascarenhas, 2009; p. 30). Essentially, several items were based on the relationship between student socio-demographic variables (e.g., parental involvement, course choices) and student achievement. This investigation focuses on well-established educational research findings in the form of teaching principles. Boser's (2019) instrument was published following that for this investigation.

Several methodological flaws identified in Nelson et al's (2017) instrument rendered it inappropriate for use here. As discussed in section 3.4.1, their investigation incorporated teachers from primary and secondary schools. Some questions compared efficacy of a strategy (e.g., homework) across primary and secondary schools. That was considered problematic for this investigation because there is little reason why secondary school teachers should become research-informed about the effectiveness of homework in raising primary school students' achievement. Consequently, although their research-based knowledge about the effectiveness of strategies in secondary school settings may be strong, they would be poorly placed to respond due to an inability to make a comparison between the two settings. The sampling validity of Nelson et al's (2017) instrument is also questionable because they attempted to measure teachers' ability to identify research-based knowledge through only eight items.

Within Teacher Survey: Section Two, teachers' ability to identify neuromyths was also explored. The importance of doing so was discussed in section 4.3 but, briefly, as highlighted by Howard-Jones et al (2009), Dekker et al (2012), and Bowers (2016) there is evidence that teachers subscribe to false knowledge in the form of neuromyths and use it to influence their practice. Some of that evidence comes from research primarily conducted to explore teachers' knowledge of 'general assertions about the brain' (Howard-Jones et al, 2009; p. 18) rather than the relationship between neuroscience and student achievement. Consequently, several items within existing instruments were not appropriate here.

**5.2.4 RQ5: What is the relationship between: a) the research-informed teaching cultures of secondary schools, b) teachers' awareness of well-established educational research findings, c) teachers' perceptions about research usefulness, and d) student achievement?** To address this RQ, data from both the Teacher Survey and School Survey were used in conjunction with participating schools' recent GCSE scores. Analysis took place at the school level because some teachers may not, or only partly, be responsible for GCSE cohorts. GCSE's were used as a measure of achievement because they are objective and standardised. A Key Stage 4 measure (rather than KS3, for example) was used because it is at this point that a secondary school will have had maximum opportunity to influence student achievement. An average of school GCSE results published by the DfE in 2017, 2018, and 2019 were used to provide a relatively stable account of each school's performance. 'Progress 8', a measure used to capture student progress from the end of primary school (i.e., Key Stage 2) to the end of Key Stage 4 was used as an indicator of each school's GCSE performance. Progress 8 is essentially a 'value-added measure' whereby each student's achievement in the following subjects is averaged and compared to that of other students nationally with similar achievement at Key Stage 2:

- Maths (double weighted)

- English (double weighted)
- 3 qualifications within the English Baccalaureate (e.g., history, geography)
- 3 further qualifications that can be GCSE qualifications (including EBacc subjects) or technical awards from the DfE approved list

A school's Progress 8 score is calculated by averaging those of all students within. Progress 8 was chosen as an indicator of GCSE performance for two reasons. Firstly, the DfE (2020; p. 6) report it as 'the headline measure' of school accountability, 'used to inform parents and students about school performance; to prompt and promote self-improvement [...] and to provide credible information to enable action in cases of underperformance'. Secondly, it captures student achievement from a broad curriculum and accounts for prior attainment which, for Hattie (2009), is the strongest predictor of future achievement. In 2017, reforms transformed GCSE scores from levels to points, the DfE calculation of how points translate into traditional levels can be seen in Table 3.1, below.

Table 3.1. DfE (2020) translation of GCSE levels to points

| GCSE Level | GCSE Points |
|---|---|
| A* | 8.5 |
| A | 7 |
| B | 5.5 |
| C | 4 |
| D | 3 |
| E | 2 |
| F | 1.5 |
| G | 1 |

## 5.3 Instruments

This section will provide detail about the methods used in developing and piloting the two created surveys. Detail will initially be provided about the School Survey and followed by the Teacher Survey.

**5.3.1 School Survey.** This survey was designed to ensure that each construct within Cain's (2018) framework was addressed and that was operationalised by dedicating one (or more) items to each construct. This strategy was adopted to enhance the survey's content validity (i.e., a measure of the extent to which all facets of a given construct are represented). In total, 15 items were created and most utilised a multiple-response (i.e., 'tick all that apply') format supplemented by an 'other' option where respondents could discuss something beyond the list provided. That format was used because it indicates to respondents the quantity of information required and the type of response sought. All items were formed in adherence with several 'rules' set out by Mellenbergh (2008), perhaps most importantly, that of clarity and simplicity to help ensure respondents understood items in the same way as intended by the researcher. This was crucial because, for Wilhelm and Andrews-Larson (2016), item misinterpretation is a common cause of reduced validity in survey-based research particularly amongst samples of teachers.

Each school's 'score' on an item was calculated simply by counting the number of options the respondent selected. For example, respondents were asked to select (from a provided list) the types of activities which school leaders use research-based evidence to inform. If a respondent checked three boxes, then a score of three was attained. The reasoning here is that schools with a more developed research-informed culture would use research to inform more activities than those with less developed research cultures. Each school's cumulative score across all School Survey items were used to make an inference about the extent to which they have taken steps to develop a research-informed teaching culture (more detail about this calculation will be provided in section 5.7).

Immediately following each School Survey item, a 5-point Likert scale item ('Not Important' to 'Highly Important') was presented and respondents were asked to rate the importance of the preceding construct of Cain's (2018) framework in developing a research-informed culture. For example, immediately following the example item previous mentioned, participants were asked the following question and required to report their response on the 5-point Likert scale: 'To create a research-informed school, how important is it that teachers are supported in using research?'. If a respondent checked box five that was taken to indicate that construct to be very important and an importance score of five was obtained. Cumulative scores across these supplementary items were used to make inferences about the importance each school places on developing a research-informed teaching culture (more detail about this calculation will be provided in section 5.7). These supplementary items were important in developing the relevant literature because, as discussed in section 3.3, although each construct in Cain's (2018) framework appears to influence the development of a research-informed culture, it remains unclear which are perceived to be most influential.

Once a draft survey was constructed, a pilot study entailing consultation with the research supervisory team was conducted to obtain face- and content-validity. Face validity reflects the extent to which items ostensibly appear to be assessing the target construct (Meyer et al, 2001) and was established following an iterative process of receiving and acting on feedback from the supervisory team which resulted in several drafts of the survey. Throughout the pilot study, several adjustments were made to the structure of the survey, along with the structure and content of each item. As subject matter experts, the research supervisory team were well-placed to confirm each item's validity in measuring the intended constructs of Cain's (2018) framework. Content validity was obtained by ensuring that each construct across Cain's (2018) framework was targeted in at least one item. Construct validity could not be systematically assessed because no other instruments in existence use the constructs formulated by Cain (2018).

**5.3.2 Teacher Survey.** Within Teacher Survey: Section One, most items were either: a) forced-choice and all possible response categories were provided (e.g., participant age), or b) 5-point Likert scale to identify participant attitudes and opinions. Some items were free-text response format for which a coding system was developed based on both the relevant literature and trends in participant responses. For example, item 10b (see Appendix 2) required respondents to describe obstacles they face in engaging with educational research. Some response categories were provisionally established based on consistent findings within the available literature (e.g., lack of time). Additional categories were created in instances were several participants provided a particular response which differed from the available literature.

Two equivalent versions of Teacher Survey: Section Two were created; both entailed a 26-item *assessment* devised to assess identify teachers' ability to identify well-established, research-based teaching principles and their impact on student achievement. The two versions differ only in Section Two (explanation will be provided shortly). The term assessment is used because they identify 'maximum performance' whereas questionnaires measure attitudes or perceptions (Mellenbergh, 2008).

Of the 26-items, 20 are well-established, research-based teaching principles and six are neuromyths. Each item asks participants whether or not, according to research, a specific teaching principle raises student achievement. Participants are advised to assume that all other variables (e.g., student behaviour) are equal. Two items were identified from each of 13 topics – for a full list of items see Appendix 3.

By drawing items from a broad range of topics, sampling validity and the representativeness of well-established, research-based teaching principles used was enhanced. This investigation endeavoured to report how accurately teachers can identify well-established research-based teaching principles therefore it was important that the survey included teaching principles from the broadest range of topics possible. As there are arguably limitless topics which relate to teaching, it was not possible to ensure that all topics were included. Drawing items from a narrow range of topics may have resulted in a bias representation of teachers' knowledge of well-established teaching principles. From each topic, two items of equal difficulty were identified to facilitate: a) cross-validation, and b) measurement of internal consistency. Internal consistency is a measure of reliability used to evaluate the degree to which different test items probing the same construct produce similar results.

Two equivalent versions of the Teacher Survey: Section Two (i.e., Question Selection A (QSA), Question Selection B (QSB)) were created to demonstrate concurrent validity. To facilitate the development of two equivalent versions, a correct and incorrect statement was created for each item. Both the correct and incorrect form could not be given to the same respondent because items would become inter-dependent. Both forms of each item were constructed to differ only between positive and negative phrasing, therefore ensuring high similarity, equal difficulty, and an equal number of true and false items across versions. Randomisation was used to: a) assign item version (i.e., correct or incorrect) to QS, and b) order items within each QS. In Appendix 3, you can see the correct and incorrect version of each statement and which QS it was assigned to.

All items in Teacher Survey: Section Two are presented as a statement with a forced true/ false response format to illuminate teachers' ability to objectively identify well-established, research-based teaching principles. This format was adopted as it would: a) provide appropriate data to address the RQ, b) not be too demanding on respondents, and c) provide appropriate data to facilitate analysis using Signal Detection Theory (SDT) (discussed in section 5.7). In formulating the items, the same 'rules' set out by Mellenbergh (2008) mentioned earlier were again adhered to. However, it was somewhat challenging to construct items with sufficient simplicity to help ensure respondents understood them in the way intended whilst also providing an accurate representation of often complicated and contingent research findings. That issue will be explored to a greater extent throughout the next chapter but appeared to be partly attributable to different conceptualisations researchers have of teaching practices (e.g., 'group work').

A two-stage pilot study was conducted for the Teacher Survey; the first stage involved consultation with the research supervisory team to obtain face, content, and construct validity. As subject matter experts, they were consulted with each item and well-placed to confirm their face validity. Content validity of each item was established primarily through comprehensive engagement with the relevant literature to ensure accurate representation. Verification was then sought from the research supervisory team that items appropriately reflected intended constructs. Bolarinwa (2015) argues that content and face validity provide some evidence of construct validity. Construct validity was established through cross-validation between the two created versions and will be discussed in section 7.1.

Most feedback from the research supervisory team related to ensuring clarity in participant instructions, instrument structure, and item content. Not all feedback was acted upon; for example, it was suggested that validity may be enhanced by presenting items individually to avoid participant 'over-thinking'. This feedback was overlooked based on evidence of quicker completion times (Mavletova & Couper, 2015), lower breakoff rates, and higher questionnaire experience ratings (Wells, Bailey, & Link, 2014) when items are listed on a single page rather than across multiple pages.

Stage two of piloting entailed distributing the Teacher Survey to 12 volunteers who share key professional characteristics (i.e., QTS/ QTLS, experience of teaching in secondary schools) with the target population. Participants were asked to complete the survey and provide general and specific (e.g., comment on item understandability) feedback. Some concern was raised about the understandability of negatively phrased items (e.g., 'Feedback that provides learners with a goal will not raise achievement'), similarly Mellenbergh (2008) also cites caution about negatively phrasing items. However, negatively phrased items were necessary to facilitate cross-validation between the two versions.

Pilot volunteer performance was explored using descriptive statistics to ensure that Teacher Survey: Section Two could distinguish between respondents' ability to identify well-established, research-based teaching principles. Seven participants completed QSA (*M* correct responses = 15; range = 12 - 22) and five completed QSB (*M* correct responses = 16; range = 13 - 22). Although each assessment item was answered correctly by one (or more) participants, some items were responded to correctly by all. However, as several pilot respondents are senior lecturers on PGCE courses, it was expected that their performance would be better than the target population.

## 5.4 **Sampling**

A convenience sampling approach was taken in recruiting schools for this investigation. Essentially, secondary schools with whom Edge Hill University (EHU) had a partnership with (commonly formed for placing trainee teachers) were targeted. That method enabled quick and relatively easy access to a broad database of schools (N = 657), 357 of which were located within the north-west of England. Secondary schools were defined as schools which provide (but are not limited to) Key Stage 3 & 4 education provision for 11-16-year olds. To ensure that the recruited sample of schools represented ‘regular’ state-funded mainstream secondary schools in England, the following school types were excluded:

- Fee-paying (e.g., private, public)
- Single sex
- Special schools
- University Technical Colleges/ Studio schools

After removing schools which did not meet the criteria, 449 secondary schools remained in the database and all were invited to participate. 17 explicitly declined and a further 395 were considered to implicitly decline after failing to respond to three invitations (two via email, one via telephone). Etikan, Musa, and Alkassim (2016) argue that convenience sampling can result in potential biases which make a recruited sample unrepresentative of the target population. Consequently, as will be discussed in section 7.1, several school and teacher characteristics were captured and compared to those of secondary schools and teachers nationwide to verify representativeness.

Each participating school was asked to distribute the School Survey to the person(s) responsible for teachers’ CPD and the Teacher Survey across all ‘fully qualified teachers’ (i.e., teachers with QTS/ QTLS). The only incentive offered to schools was promise of a summary of this investigation’s general findings. It was not appropriate to provide school-specific survey findings because it could have led to participating teachers being identified within their school. No incentive was offered directly to teachers.

### 5.5 Procedure

Once ethical approval had been obtained (see section 5.6), schools meeting the imposed criteria were sent a tailored invitation. Invitations were sent via e-mail to the Professional Mentor (i.e., the person whom EHU liaise with matters relating to teacher training placements) within each school and detailed the rationale, objectives, and requirements of this investigation (see Appendix 4). If no response to the initial invitation was received within two weeks, then a follow-up email was sent. After a further two weeks, a final invitation was made by telephone to schools which failed to respond to either email. Most schools failed to respond to any invitation, and that was taken as an implicit refusal to participate.

Each school which agreed to participate was emailed a link to the Teacher Survey and asked to distribute it across all fully qualified teachers. Upon accessing the link, participants were presented with an information sheet, briefed about the investigation, and required to provide consent before progressing. Upon completion of the survey, participants were thanked for their participation, debriefed, and given contact details should they have any questions or wish to withdraw their data. The Teacher Survey was open for eight weeks and schools were sent two follow-up emails further encouraging them to distribute the survey across relevant teachers. The first follow-up email was sent after three weeks and the second was sent one week before the survey closed.

Upon closure of the Teacher Survey, each school liaison was again contacted and asked to provide contact details for the person(s) responsible for teacher CPD. Usually, this was the same person with whom contact had been ongoing and they were invited to complete the School Survey. The process followed here was similar to the Teacher Survey as participants were presented with an information sheet and required to provide consent upon accessing the survey. Immediately following completion of the survey, participants were thanked for their participation, debriefed, and presented with contact details should they have any questions or wish to withdraw their data (see Appendix 1).

## 5.6 Ethical Considerations

This investigation adhered to guidelines set out by the British Educational Research Association (2011) and EHU Code of Practice for the Conduct of Research. Ethical clearance was obtained following scrutiny from EHU Research Ethics Committee prior to collecting data. Only data necessary and relevant for this investigation was collected. Data gathered from the EHU partnership database was obtained prior to recent GDPR changes. As discussed in section 5.4, schools were offered a general summary of this investigation's findings and teachers were offered no incentive. Only adults were recruited, none of whom were considered vulnerable, and all participants:

- Were briefed about the overall aims and procedure
- Provided voluntary informed consent prior to participation
- Were given the right to withdraw their data
- Were treated with respect and dignity
- Partook without the risk of physical or psychological harm
- Had data that they provided kept private and confidential

### 5.7 Analytic Strategy

Chapter Seven is split into three sections: Initial Data Analysis (section 7.1), Main Data Analysis (section 7.2), Additional Analysis (section 7.3). The Initial Data Analysis section will explore the extent to which the teacher and school samples are representative of their target populations, and the reliability of both surveys. To provide an example of the former, analysis will be conducted using eligibility for free school meals (eFSM) and number of students on-roll to verify the representativeness of the recruited school sample against those comparable nationally. For the latter, internal consistency of both surveys will be computed to explore their reliability.

The Main Data Analysis section will explore data for RQs 2-4 initially using descriptive statistics (e.g., measures of dispersion and central tendency) and correlational analyses. For RQ2, data from each School Survey item will then be used to create two variables. The first, 'total research-informed culture', represents the extent to which each school takes steps towards developing a research-informed teaching culture and was calculated by summing, standardising, and averaging responses to each School Survey item. The second variable, 'total importance', reflects the overall importance that each school places on developing a research-informed teaching culture. Total importance scores were calculated in the same way as previously mentioned with the only difference being that data was taken from the scale items supplementing each School Survey item.

For RQ3, the Main Data Analysis section will largely consist of exploring the data for each item in Teacher Survey: Section One and providing supporting evidence (usually using respondent quotes) to support interpretations and response categorisation. Analysis for RQ3 will conclude by using data from those items to create a standardised variable labelled 'teacher attitudes towards the usefulness of educational research findings'. For RQ4, SDT was used to compare teachers performance in Teacher Survey: Section Two against that which would be expected by chance. SDT is a theory about decision-making which postulates that decisions are made in the presence of some uncertainty and based on a weight of perceived evidence favouring one of any given number of hypotheses (i.e., outcomes) (McNicol, 1972). Each participant was subjected to 26 'trials' (i.e., Teacher Survey: Section Two items) and asked to state whether each was true or false (according to research findings). Of the trials, 13 were correct statements (according to research findings) and the remaining 13 were false. Using SDT, there are four possible trial outcomes (Table 5.1, below): hit (correct 'true' responses), false alarm (incorrect 'true' responses), correct rejection (correct 'false' responses), or miss (reporting 'false' when it should be 'true'). A participant who states that all items are true is guaranteed all hits but will also incur all false alarms. On the other hand, a participant who consistently reports items to be false will correctly identify all correct rejection trials but also incur all miss'.

Stanislaw and Todorov (1999) and McNicol (1972) discuss two variables fundamental to SDT. The first, *sensitivity* (i.e., *d'),* refers to a participant's ability to make accurate judgements and avoid inaccurate judgements. A high *d'* score indicates that a participant can accurately identify well-established, research-based teaching principles from those that are not. A d' score close to zero indicates that a participant's performance is similar to that expected through chance. Calculating a participant's sensitivity is necessary because gross measures (e.g., number of correct responses) of performance are confounded by a participants criterion (second variable to be discussed in next paragraph). *d'* is calculated using a participant's hit rate and false alarm rate. Hit rate is calculated by dividing the number of hits by the number of hit trials. Hit trials are those entailing a *correct* statement about a well-established, research-based teaching principle. False alarm rate is calculated by dividing the number of false alarms by the number of false alarm trials. False trials are those entailing an *incorrect* statement about a well-established, research-based teaching principle. Stanislaw and Todorov (1999) calculate *d'* by subtracting the z-score of the proportion of false alarms (i.e., false alarm rate) from the z-score of the proportion of hits (i.e., hit rate). A z-score makes *d*' comparable across studies.

The second measure, *bias criterion* (i.e., *C*)*,* indicates a participant's strategy; whether they favoured one hypothesis (or direction) over another. For example, some participants may be bias towards reporting teaching principles as being 'true' (according to research findings) and therefore have a lower criterion for considering a teaching principle to be true and would achieve lower *C* values (i.e., <0). A participant with a higher criterion would be less likely to report teaching principles to be 'true' and therefore have a bias towards reporting each trial to be false and produce higher *C* values (i.e., >0).

*C* is found by averaging the summed z-scores of a participant hit rate and false alarm rate. *d'* and *C* were calculated in Microsoft Excel using function formulae provided by Stanlisaw and Todorov (1999). The same functions were calculated in SPSS and correlations (both correlations (r (425) = 1.00, *p* = < .01)) were conducted across results to ensure there were no discrepancies.

Table 5.1. SDT response outcome matrix

| | **Respond 'False'** | **Respond 'True'** |
|---|---|---|
| **Correct Statement** | Miss (0) | Hit (1) |
| **Incorrect Statement** | Correct Rejection (2) | False Alarm (3) |

For RQ5, an explorative between-schools linear regression analysis was conducted and, depending on its outcome, a multilevel analysis may also be utilised. In justifying the adopted strategy, Hattie (2009) illustrates that education is highly complex and there are almost innumerable variables within and beyond the school environment which can influence student achievement. However, as illustrated during section 3.7, there is some evidence that research engagement at the teacher and school level can potentially improve student achievement.

To account for some of the other variables which can influence student achievement and therefore provide a more accurate account of the influence of the variables in focus, an additional variable - eFSM - was included in the regression analysis. Taylor (2018) reports that eFSM is extensively used as a proxy of student socio-economic deprivation by academics and policy-makers domestically and internationally (e.g., Stronge et al, 2007). Both agents reportedly use eFSM to capture the gap in achievement between students of different socio-economic statuses, with policy-makers also using it to direct funding to socio-economically deprived students. EFSM is a favoured indicator of socio-economic deprivation because it has a consistent definition, data is routinely collected and it correlates positively with several other variables which can influence achievement (e.g., 'cultural capital') (Ilie, Sutherland, & Vignoles, 2017).

There are some limitations of using eFSM as a proxy of socio-economic deprivation. Firstly, parents must apply to be considered eligible therefore some students who are eligible may not be registered as such. Sahota, Wooward, Molinari, and Pike (2014) estimate that 17 - 20% of students who would be eligible are not registered. Since Sahota et al's (2014) research, several strategies have been implemented to increase the registration rate. Secondly, eFSM may not capture those living in the most extreme poverty once welfare benefits are accounted for. Despite those criticisms, eFSM continues to be used and that is perhaps because data supporting alternative measures of socio-economic deprivation (e.g., social class, parents' education) are more difficult to acquire.

Using a longitudinal research design and a sample of 12,678 students across 358 secondary schools in England, Ilie et al (2017) found that eFSM was a statistically significant predictor of attainment and explained 23.3% of within-school GCSE variance. Non-eFSM learners generally gained one grade on their counterparts across GCSEs. Ilie et al (2017) also found: a) a strong positive correlation between eFSM and other measures of socio-economic disadvantage, and b) the predictive power of eFSM to be only marginally weaker than the strongest socio-economic indicators (i.e., parents' education) of student achievement. Taylor (2018; p. 46) has since reinforced the findings of Ilie et al (2017), arguing that eFSM is a 'very good' measure of socioeconomic status and there is a strong negative correlation between literacy and eFSM for learners aged 11. Similar relationships between eFSM and student achievement have also been obtained in other countries (e.g., Stronge et al, 2007).

Should the regression analysis reveal relationships between the variables in RQ5 and substantial variation at the school and teacher level then multilevel analysis would be conducted. Multilevel analysis facilitates exploration between individuals and between individuals and the context in which they operate; it accepts that influence between individuals and their context is reciprocal (Hox, Moerbeek, Moerbeek, & van de Schoot, 2018). In this investigation, there is a hierarchical system consisting of teachers (level one) who are nested within schools (level two). Multilevel analysis acknowledges that teachers within schools are likely to be more similar than teachers between schools and better facilitates analysis of variation within- and between- schools and inter-level interactions.

# Chapter Six: Identifying Well-Established, Research-Based Teaching Principles

A central aim of the current investigation is to identify teachers' knowledge of teaching principles and how effective they are in raising student achievement when implemented in the classroom. Therefore, it was necessary to identify teaching principles which reportedly raise achievement and ensure that they are supported by evidence obtained through methodologically robust research. This chapter will detail the process followed to identify, and the research evidence supporting, the teaching principles included within the Teacher Survey: Section Two.

## 6.1 Definitions

'Teaching principles' are defined as general rules that can govern the classroom practice of teachers. Those encompassed within the Teacher Survey: Part Two are each argued to be 'researc h-based' and 'well established'. Being 'research-based' meant that evidence supporting each principle's impact on student achievement was sourced from the findings of methodology robust educational research, for which criteria was instated and will be discussed in section 6.2. Ensuring that each principle was research-based was important in maintaining validity and aligning with the government drive for research-informed education.

The term 'well-established' relates to the consistency, or consensus, with which educational research literature reports that the principle positively impacts student achievement. It was considered necessary that included teaching principles have an extensive research body consistently evidencing a substantial positive effect on student achievement. As highlighted within the EEF Toolkit (2018), research rarely provides conclusive a conclusive evidence base, therefore a teaching principle was considered well-established providing the relevant research literature reported predominantly supportive evidence. Usually, research syntheses (e.g., meta-analysis) can provide a good starting point for identifying which teaching principles are well-established.

Importantly, there are some exceptions to the above rule. To explain, within the Teacher Survey: Section Two, there are six neuromyths and two items within the topic of *ability grouping* (see section 6.4.5). As has been discussed in section 4.3, there is a weight of evidence to suggest that neuromyths will not raise achievement when operationalised in the classroom. Similarly, it has become well-established through robust educational research that ability grouping is not an effective way to raise achievement.

## 6.2 Literature Review & Inclusion Criteria

A two-stage process was implemented to identify well-established, research-based teaching principles. Stage One was conducted to identify teaching principles communicated to teachers usually via practitioner texts as having a positive impact on student achievement. Stage One involved a review of literature that: a) teachers have reasonable access to, and b) reported causal relationships between teaching practices and student achievement. Stage Two involved delving into the research literature supporting each teaching principle identified in Stage One to ensure that they were indeed well-established through activity which constituted research (hence 'research-based').

**6.2.1 Stage One.** Several criteria were set out prior to engaging with practitioner texts to ensure a systematic approach. Only practitioner texts meeting the following criteria were read:

1. Accessible to teachers
2. Evidence of wide readership
3. Primarily based on the findings of research
4. Teaching principles relevant to teachers' practice
5. Teaching principles relevant for secondary schools

***Criterion One: Accessible to teachers.*** Practitioner texts accessed were necessarily reasonably accessible to teachers because it would be unfair to assess their knowledge of literature which they are unlikely to have access. Consequently, practitioner texts that could not be reasonably accessed (e.g., subscription-only journals) were excluded. The practitioner texts identified here have been sourced either online (without cost) or via EHU library. From personal professional experience as a teacher, secondary schools often provide access to a small selection of practitioner texts.

The inclusion of practitioner texts has been made with caution due to the journey that research takes before being cited in a practitioner text. Briefly, research is conducted and subsequently published in academic journals where the findings are considered by peers who may interpret and, potentially, later cite those findings in practitioner texts. Problematically, original research findings can be conflated between initial investigation and subsequent publication in practitioner texts. This issue was addressed during Stage Two where the findings of individual investigations, upon which practitioner texts are based, were accessed to ensure that they were accurately represented.

***Criterion Two: Evidence of wide readership.*** To maintain validity, it was important to identify practitioner texts which were respected and utilised by teachers. Examples of acceptable evidence included sales figures, number of published editions, subsequent academic citations. Lacking evidence of readership could indicate that teaching principles cited within those texts have not been comprehensively read by teachers. As neither sales nor number of views could be identified for all identified resources, no specific threshold constituting 'wide-readership' was created.

***Criterion Three: Primarily based on the findings of research.*** To help verify the validity and methodological robustness of teaching principles within practitioner texts, it was important that each accessed text was predominantly sourced from peer-reviewed academic research. The importance of this criterion is illustrated by Boser (2019) who, following a review of teacher training textbooks, report that they sometimes 'passed off ideas with little research support as hard science' (p. 2). It was unrealistic to necessitate that resources were entirely based on peer-reviewed research because several key resources would have been excluded. For example, despite huge popularity, Hattie (2009) would have been excluded following inclusion of conference papers, masters and doctoral theses.

***Criterion Four: Teaching principles relevant to teachers' practice.*** A decision was made that teachers' knowledge only of principles that may influence their planning of, or conduct within, their professional practice should be assessed. A principle must be relevant for practice to the extent that is almost entirely under the control of the teacher. Therefore, literature investigating the impact of, for example, feedback strategies on achievement was included as teachers are in control of planning and administering it, and as such their professional practice likely be influenced by it.

***Criterion Five: Teaching principles discussed relevant for secondary schools.*** Secondary school teachers of all subjects were invited to participate in this investigation. Therefore, it was important that the teaching principles encompassed were relevant and generalisable across all secondary school teachers. For example, teaching principles which reportedly apply only to teachers of vocational subjects were excluded.

Practitioner texts which met the instated criteria can be found in Table 6.1, along with examples of those which did not. Within those that met the instated criteria, the aim was to identify 'well-established' teaching principles which reportedly positively impact student achievement and progress them to Stage Two. For a teaching principle to be considered 'well-established', agreement between practitioner texts about its positive impact on student achievement was necessary. To meet this criterion, it was not essential for all accessed practitioner texts to discuss a principle. However, a consensus was necessary amongst those which did discuss a given principle about the positive impact it is likely to have on achievement.

**6.2.2 Stage Two.** This stage was designed to ensure that identified teaching principles were based on methodologically robust research and this was achieved by examining individual studies upon which discussion in the practitioner texts was based. It was not considered necessary that investigations accessed in this stage were accessible to teachers. The following methodological and outcome criteria were imposed on individual studies accessed before their respective findings were admitted to the bank of evidence being built to justify each principle's inclusion as being 'well-established' and 'research-based':

A. Evidence of a substantial positive impact on student achievement
B. Quantitative research with an experimental or quasi-experimental design
C. Conducted in educational setting (preferably a primary or secondary school)
D. Included an objective measure of learning outcomes
E. Conducted within the previous 40 years

***Criterion A.*** Effect sizes are the standardised mean difference between two groups and were identified within each investigation to identify the magnitude of each teaching principle's impact on student achievement. An effect size of 0.8 means that the score of the average person in an experimental group is 0.8 standard deviations above the average person in a control group (thereby exceeding the scores of 79% of the control group).

Effect sizes more appropriately measure impact than statistical significance because the latter can conflate the actual size of the effect and be affected by sample size. Hattie (2009) reports that the mean effect size of educational research is $d$ = 0.4, consequently teaching principles were required to produce $d$ > 0.4 to constitute having a substantial positive impact on student achievement. The EEF Toolkit (2018) reinforces the use of $d$ = 0.4 as a 'hinge-point', proposing that it has become a conventional threshold within educational research.

***Criterion B.*** The rationale behind this criterion is a consequence of the current 'what works' initiative and political preference driving researchers towards comparative educational research with a (quasi-) experimental design. (Quasi-) Experimental research designs are particularly useful for identifying causal relationships between variables. For research to be considered 'experimental', manipulation of variable(s), control group comparison, tests of statistical significance, random participant assignment (quasi-experiments exempt), and equivalence (or control for lack of equivalence) of pre-experiment group differences were necessary.

The internal validity of quasi-experimental research is inferior to experimental research because the former lack random assignment of participants to conditions and/or orders of conditions. However, steps (e.g., pre-/post-test design) can be taken to ensure that either: a) groups being compared are similar, or b) pre-existing differences between groups are accounted for. It was deemed reasonable to include quasi-experimental research because allowing only experimental research would have negated too much educational research.

***Criterion C.*** By endeavouring to include only research conducted in either a primary or secondary school, more confidence can be assumed that subsequent findings are generalisable across secondary schools. Research conducted in early years and higher education settings was admitted only when that conducted in the preferred settings was limited. Research conducted in workplace settings offers little contextual and demographic resemblance to secondary schools and was excluded.

***Criterion D.*** An objective measure of student achievement was necessary to ensure validity in determining each principle's impact. Investigations utilising subjective measures of achievement (e.g., teacher/ student report) or proxy measures of achievement (e.g., student motivation, engagement) were excluded as they do not necessarily directly translate to impact on achievement.

***Criterion E.*** The research cut-off period of 40 years was selected for three reasons. Firstly, Bradley et al (2008) argue that there is little evidence that educational contexts have changed within recent years to an extent whereby previous research findings would no longer be relevant. Secondly, pragmatically it became increasingly difficult to access research conducted >40 years ago.

Finally, as will be demonstrated throughout the main body of this chapter, research evidence created during the past 40 years was sufficient in reinforcing the cited teaching principles as being 'well-established'. For example, Terhart (2011) notes that most research analysed by Hattie (2009) was conducted during the 1980s and 1990s. Whilst the age of research potentially has implications for teachers in the inferences they should take from respective findings, that research remains valuable as evidence about the extent to which principles have impacted student achievement. The situation becomes complicated here because questioning the usefulness of research investigating the impact of computer-assisted instruction on student achievement conducted in the 1990s would be less appropriate following rapid developments in educational technology. Arguably, however, research conducted in the 1990s investigating classroom practices (e.g., homework) that have not been the subject of rapid development may retain more usefulness for teachers.

## 6.3 Limitations of Imposed Criteria

During Stage One, it was often unclear about the extent to which practitioner texts were actually based on the findings of peer-reviewed academic research. For example, few practitioner texts detail methodological inclusion criteria upon which their propositions are based, many simply promote a teaching principle and conclude discussion by listing supporting academic references. That is justifiable because practitioner texts are created for teachers, for whom discussion of methodological inclusion criteria is likely unimportant. The EEF (2016) state that only systematic reviews and meta-analyses with quantitative data including effect sizes were included in their Toolkit. That is potentially problematic, as Snook et al (2010) argue, because heterogeneity in methodological inclusion criteria both within and between research syntheses (i.e., some including only experimental studies, others including less-well controlled case studies) can have implications when calculating and interpreting effect sizes. With that said, modern meta-analyses can deal with heterogeneity by including moderating variables (e.g., research design) and measuring their influence on changes to the outcome variable.

Although weight has been placed on effect sizes, interpreting those provided in research syntheses should be considered in conjunction with the number of studies included within the synthesis. Some problems which can arise from that can however be controlled by providing sample-weighted mean effect sizes (e.g., Hattie, 2009; EEF Toolkit, 2018). Where weighted mean effect sizes are are not provided, inferences taken from a moderate effect from a small number of studies should be drawn with caution. To some extent that issue was negated through Stage Two because providing the methodology used in individual studies is robust then respective findings remain informative.

Though possibly exposing this investigation to criticisms of favouring a positivist paradigm, the inclusion criteria imposed at Stage Two essentially excluded qualitative, correlational, pre-experimental, and observation-based research. That decision is justifiable as identifying cause-effect relationships is a strength of comparative quantitative research which was essential for this investigation. Admittedly, some research questions cannot be answered appropriately through quantitative research.

As discussed by Shadish, Cook, and Campbell (2002), (quasi-) experimental research has methodological limitations. Firstly, obtaining internal validity can be challenging as learners and teachers will likely be aware that they are part of an investigation and, as such, may not behave normally (i.e., 'Hawthorne effect'). Secondly, necessary imposition of strict controls to establish cause-effect can reduce external validity, however, without strict controls there is increased risk of confounding variables impacting the investigation and subsequent potential for type I and type II errors. Further methodological concerns inherent in experimental research include potential experimenter bias and sample selection & assignment bias. Although the cited issues cannot be ruled out, they can be minimised by ensuring that a) the experiment is well-designed, b) pre-existing differences between groups are accounted for, and c) the data gathered is analysed using appropriate statistical techniques.

Table 6.1. Practitioner texts accessed

| Practitioner text | Accessibility to teachers | Evidence of readership amongst teachers | Research focus | Included? (reason for exclusion) |
|---|---|---|---|---|
| Meta-Analytic Review of Experiments Examining the Effects of Extrinsic Rewards on Intrinsic Motivation (Deci, Ryan, & Koestner, 1999) | Free access via Google. Cited in seven practitioner textbooks. | Little evidence of teacher readership. | Synthesis of 128 studies examining effects of extrinsic rewards on intrinsic motivation. | No (excessive grey literature) |
| What if everything you knew about education was wrong (Didau, 2015) | Amongst Amazon's best-selling practitioner texts. Cited in two further practitioner textbooks. | Based on the 18th most influential educational blog' worldwide, and the most influential in the UK (Onalytica.com, 2013). | Challenges common teaching assumptions using research evidence from cognitive science. | Yes |
| Classroom Instruction that works: Research-based strategies for increasing student achievement (2nd Edition) (Dean, Hubell, Pitler, & Stone, 2012) | Available for circa. £15. Cited in +10 practitioner textbooks. | First edition published in 2001. Amongst best-selling in Classroom Strategies & Policy on Amazon. | Builds on evidence base formed in the extensive meta-meta analysis (Marzano, 1998) across nine teaching topics. | Yes |

| | | | | |
|---|---|---|---|---|
| Why Students Don't Like School: A Cognitive Scientist Answers (Willingham, 2009) | Free access via Google. Available in paperback and kindle editions for circa. £10. Cited in +10 practitioner textbooks | In Amazon's top 10 best-selling Educational Psychology and Philosophy of Education books. | Nine principles of cognitive psychology that can applied to education and 'do not change with circumstances' (p. 2). | Yes |
| How We Learn (Illeris, 2007) | Free access via Google Available for circa. £25 Cited in 4 practitioner texts | Little evidence of readership amongst teachers. | Unpicks processes and conceptions of learning, critically assessing different types of learning and obstacles to learning. | No (lacking readership evidence) |
| Visible Learning: A Synthesis of over 800 Meta-Analyses Relating to Achievement (Hattie, 2009). | Summary available via Google. Available for circa. £25 Published in 7 languages | Acclaimed as "Education's Holy Grail" (Times Educational Supplement, 2008). Cited by 5457 sources (Google scholar, 2017). | Synthesises over 800 meta-analyses (>50,000 studies) investigating influences on student achievement. | Yes |
| How to be a Brilliant Teacher (Wright, 2009) | Available for circa. £20. | Little evidence of readership. | Provides 'practical practitioner advice' (p. 3) for creative lesson planning, managing learning, and differentiation. | No – lack of peer-reviewed research or |

| | | | | |
|---|---|---|---|---|
| | | | | evidence of readership |
| The Psychology of Academic Achievement (Winne & Nesbit, 2010) | Free access via Google. | Cited in multiple practitioner textbooks. | Reviews impact of metacognition on student achievement | Yes – difficult for journal articles to evidence readership |
| What Makes Great Pedagogy: Nine Claims from Research (Husbands & Pearce, 2012) | Free access via Google. | Created by highly-respected National College for Teaching and Leadership. Promoted through Gov.uk. | Overview of research relating to nine principles of 'great pedagogy'. | Yes |
| Sutton Trust- EEF Toolkit | Free access via Google. | 20,000 online viewers monthly. Used by 64% of school leaders to inform decision-making (National Audit Office, 2015). | Synthesises >11,000 individual investigations across 34 teaching topics. | Yes |

## 6.4 Research Evidence Supporting Identified Teaching Principles

Hereon, a review of the research evidence supporting each teaching principle within the Teacher Survey: Section Two will be offered. Broadly, discussion for each principle will take the following structure:

a) Topic from which teaching principles are derived
b) Well-established, research-based teaching principle assertions included in Teacher Survey: Section Two
c) Definitions of relevant terminology and a summary of how the stated assertions are communicated to teachers
d) Synopsis of supporting evidence for principle obtained through research syntheses and then robust individual investigations

Slight variation in structure may be observable between principles however that will be made clear at the outset of the respective section. Research will be presented in chronological order (i.e., earliest research discussed first). Positive effect sizes to be discussed favour intervention participant groups.

### 6.4.1 *Group Work.*

(Individual accountability) *'Group work is more effective in raising achievement if group members are given equal accountability'*

(Common group goals) *'To make group work effective, group members should be working towards a common goal'*

'Group work' refers to collaborative learning structures which are instruction methods whereby learners work together in small groups to achieve a goal, the term 'group work' will be used to ensure language accessibility for teachers. Instructional methods that researchers often draw under the umbrella of collaborative learning include: Learning Together, Jigsaw Grouping, Teams-Games-Tournaments, Group Investigation, and Student Teams Achievement Division (EEF Toolkit, 2018).

Several practitioner texts (i.e., EEF Toolkit, 2018; Dean et al, 2012; Didau, 2015) summarise the research literature surrounding collaborative learning and support the stated assertions. 'Individual student accountability' exists when students: a) share responsibility for their learning, and b) individual accomplishments contribute to other group members' learning. For individual accountability to be operationalised effectively, group success must depend on individuals completing their assigned task.

Slavin, Leavey, and Madden (1984) conceived 'common group goals' as 'two or more individuals being interdependent for a reward they will share if successful as a group' (p. 421), this definition remains commonly used throughout the literature. Common group goals could be incorporated into a collaborative learning task by providing all group members with the same recognition based on group accomplishments.

Problematically, there is little research (that meets the instated criteria) comparing collaborative learning methods incorporating effectively operationalised individual accountability and common group goals against those which have explicitly not. Instead, there are investigations whereby individual accountability and common group goals are claimed to be have been operationalised, however, it will be argued that they have not been operationalised appropriately. Consequently, comparisons are made between investigations which have effectively operationalised those principles against those which have not. Such comparisons are not ideal because studies of differing measures, durations, and participant samples, (which could each explain different findings) will be compared. This issue can be somewhat allayed through reassurance that all research discussed meets the instated criteria.

Johnson, Johnson, and Stanne (2002) conducted a meta-analysis of 164 studies post-1970 investigating the effectiveness of eight collaborative learning methods against competitive or individualistic learning methods on student achievement. They define competition as the presence of 'negative goal (or reward) interdependence' (p. 11), for example; offering rewards/ punishments based on student ranking in task performance. Individualistic learning methods involved teachers intentionally restricting student interaction. Controls were included to ensure that assessed investigations appropriately operationalised both common group goals and individual accountability. Seventy-four studies included randomly assigned participants to conditions, 41 randomly assigned groups to conditions, and the remainder did not randomly assign. Most (75) studies were conducted in primary schools, 50 in secondary schools, and the remainder utilised adult educational settings. Ninety-five studies included interventions lasting <29 hours, and the remainder lasted >30 hours.

When compared against competitive learning methods, seven (of eight) collaborative learning methods had a significant positive impact on achievement ($p$ <.05) with a moderate mean weighted effect size ($d$ = 0.49). Against individualistic learning methods, data for only four of eight collaborative learning methods is provided. Three of those had a significant positive impact on student achievement ($p$ <.05) with a similar mean weighted effect size ($d$ = 0.53). Student achievement was measured through the 'quality of performances, presentations, and products (such as reports)' (Johnson et al, 2002; p. 12).

Whicker, Nunnery, and Bol (1997) conducted a quasi-experiment comparing the effects of Student Teams Achievement Division (i.e., a collaborative learning method) against traditional instructional methods in 16-18-year-old students across two mathematics cohorts. Although utilising a small sample ($n$ = 31; experimental $n$ = 15), this study further illustrates the robust research designs, various contexts, student ages, and subjects upon which the cited propositions are based. One class was randomly designated to the control condition, and 'previous semester grades served as the basis' for recruitment to the experimental condition (hence quasi-experiment). Individual accountability and common group goals were present in the experimental group by enabling students to earn additional points based on other group members performance against their 'base scores' (calculated using data from previous semester). Both conditions were taught simultaneously and the control group could receive additional points based on their individual improvement. Students were assessed at equal intervals using teacher-created tests. Validity of assessment items and inter-rater scoring reliability were verified through review with an external subject specialist. A t-test using students' base scores revealed no significant pre-existing achievement differences between groups. A repeated-measures MANCOVA (pre-test achievement as covariate), revealed a significant condition x time interaction (*F* (3, 86) = 29.41, *p* <.001) with differences in achievement between conditions increasing (favouring the experimental condition) as the investigation progressed. Experimental participants outperformed control participants in the first two assessments, but differences were not statistically different. At assessment three, experimental participants scored significantly higher than control participants (*F* (1, 28) = 4.57, *p* = .04; *d* = 0.87). Although the groups did not differ significantly on the pre-test, they may have differed on unmeasured variables. Therefore, selection bias cannot be entirely ruled out as an explanation for the findings.

Kose, Sahin, Ergun, and Gezer (2010) conducted a five-week experiment to identify the effect of Learning Together (i.e., a collaborative learning method) on science achievement of 68, eighth-grade Turkish students. Two cohorts were randomly assigned to a condition; experimental condition (*n* = 33) utilised Learning Together; control group utilised traditional instruction methods. Experimental condition operationalised individual accountability and common group goals by assigning each group member with a task that would inhibit group progress if not completed. Both groups received 15-hours teacher contact.

Achievement was measured using teacher-created pre- and post- multiple-choice assessments. Content validity of assessment items was verified following review with two science teachers and a curriculum specialist. Assessment reliability obtained through Kuder-Richardson (KR-20) in a 'similar' school (KR-20 = 0.85). Independent and paired t-tests were used to identify significant within- and between- groups, pre- and post-experiment differences. A pre-experiment t-test revealed no significant differences between groups (*p* > .05). Post-experiment, the experimental group scored significantly higher than pre-experiment (*t* (66) = -20.997, *p* < .05). Moreover, achievement in the experimental condition increased to a significantly greater extent than the control group (*t* (66)= 4.902, *p* <.05, *d* = 1.26). Notably, analysis using pre-test scores as a covariate and post-test scores as a dependent variable would have been a more robust form of analysis.

The research discussed thus far has demonstrated the effectiveness of collaborative learning interventions that effectively incorporate individual accountability and common group goals on student achievement. Those findings will be compared against investigations utilising collaborative learning methods which failed to operationalise those principles. Topping et al (2011) compared science achievement across nine UK secondary schools between collaborative learning methods and traditional instruction methods of 644, 12-14-year-old students (experimental $n$ = 259). Across participating schools, 12 self-selected science teachers created and implemented collaborative learning methods. Student achievement was measured using a standardised 61-item assessment. Pre-test, experimental condition students achieved higher scores than the control condition. Using pre-test achievement as a covariate, ANCOVA revealed that the control group improved to a significantly greater extent ($p$ = .03; $d$ = 0.53) than the experimental condition. Topping et al (2011) make no mention about whether the collaborative learning methods implemented necessitated student inter-dependence, without it individual accountability cannot be effectively operationalised. There is also little evidence of a common group goal because assessments were completed individually.

Souvignier and Kronenberger (2007) investigated the effects of collaborative learning methods on student mathematics and science achievement across nine, mixed-ability, third-grade classes (student age 7-8 years) from three schools ($n$ = 208) in Germany. Three conditions of instruction were compared: jigsaw (i.e., collaborative learning method), jigsaw & questioning, and traditional instruction (i.e., control group). Students in the 'jigsaw & questioning' condition were treated alike the jigsaw condition but also taught to question peers in their group. One cohort from each school was randomly assigned to each condition.

All groups received six lessons and completed a pre-, post-, and delayed-test (2-3 months post-experiment) encompassing 10-20 items. Inter-rater reliability ($r$ = .98) and internal consistency ($a$ > .70) was strong across assessments. Teachers in experimental groups reportedly emphasised individual accountability to students, however no detail is given about how implemented interventions necessitated it. Consequently, it is difficult to clarify whether individual accountability was appropriately operationalised. Additionally, as students across all conditions were assessed individually, it is unclear whether common group goals were instated.

T-tests revealed statistically significant improvement for each condition from pre- to post-test (all *p*s < .01). Notably, all pre-tests revealed a superiority of the control group over both experimental conditions combined for maths ($p < .01$) but not science ($p = .10$). Due to 'differences in unit-specific knowledge prior to instruction' (p. 763), gain scores were used to measure progress. Notably, for Williams and Zimmerman (1996) gain scores can compromise reliability. Gain scores from pre- to post-test and pre-test to delayed-test were compared using ANCOVA (vocabulary and reading comprehension as covariates). No significant achievement gains from pre- to post-test were revealed between conditions in maths ($p > .05$). In science, however, student achievement was significantly greater in the control condition than either experimental condition ($F$ (2, 202) = 5.95, p < .01) (jigsaw $d = -0.28$; jigsaw & questioning $d = -0.44$). In the delayed-tests, differences between all groups were insignificant (all maths p > .05; science p > .05). In combination with the findings of Topping et al (2011), these findings suggest that when collaborative learning methods do not necessitate individual accountability and common group goals their effectiveness in raising achievement is compromised.

#### 6.4.2 Massed vs. spaced practice.

(Knowledge acquisition) *'Students will learn more if taught across three daily 1-hour sessions than a single 3-hour session'*

(Knowledge retention) *'Students will remember more if a set learning time is spread over a long time-period rather than condensed into a short time-period'*

Massed practice involves learning with little rest period between sessions. Spaced practice allows extended rest periods between sessions. Donovan and Radosevich (1999) argue that spaced practice more effectively raising student achievement than massed practice 'is one of the more strongly accepted ideas within task performance and learning literatures' (p. 795). Vlach and Sandhofer (2012) reinforce that, suggesting 'the spacing effect is arguably the most replicable and robust finding from experimental psychology' (p. 1138).

Numerous studies have demonstrated spacing benefits for acquisition and retention of vocabulary (Bloom & Shuell, 1981), facts and word lists (Zechmeister & Shaughnessy, 1980). Several practitioner texts (e.g., Hattie, 2009; Dean et al, 2012; EEF Toolkit, 2018) also promote spaced learning as a more effective method of raising achievement than massed learning. Hattie's (2009) synthesis includes two meta-analyses ($k$ = 63; number of effects = 112) providing a high overall effect size ($d$ = 0.71) favouring spaced learning. Experimental research investigating the impact of practice distribution on student achievement often follow a similar procedure: equal learning time is either condensed into a single period (i.e., massed practice) or spread across several sessions (i.e., spaced practice) before learning is assessed.

Lee and Genovese (1988) conducted a meta-analysis ($k$ = 42, number of effects = 52) examining the effect of practice distribution on motor skills development. Learning through spaced practice improved both acquisition ($d$ = 0.96) and retention ($d$ = 0.53) of motor skills when compared with massed practice. Admittedly, motor skill development is arguably only useful in select subjects (e.g., physical education, design technology). It may be more useful for most secondary school teachers to identify the effect of practice distribution on developing cognitive skills.

Donovan and Radosevich's (1999) meta-analysis ($k$ = 63, number of effects = 112) investigated the impact of practice distribution across various cognitive tasks. The following inclusion criteria were imposed; massed vs. spaced practice comparison, dependent variable measuring acquisition or retention performance, and adult participants (researchers were primarily focusing on workplace contexts). Various task-type clusters were identified reflecting the skills and/or knowledge learned. The cluster characterised by 'high mental requirements, low physical requirements, and average overall complexity' (p.798) will be discussed as it most appropriately reflects academic demands of most secondary school subjects. Examples of tasks include free recall, learning foreign language, word processing, and verbal discrimination. Across all task-type clusters spaced practice enhanced overall performance (acquisition and retention) over massed practice ($d$ = 0.46; 95% CI = 0.42 - 0.50), moderate effect sizes were identified for retention ($d$ = 0.45) and acquisition (*d* = 0.51). From the 58 effects identified for the cluster of task-types in discussion, the overall effect size remained substantial (*d* = 0.42). Donovan and Radosevich (1999) suggest that the similar effect sizes between acquisition and retention may be due to the adopted definition of retention as 24-hours being inadequate for distinguishing between acquisition and retention.

Sobel, Cepeda, and Kapler (2011) investigated the effect of practice distribution on knowledge retention in a Canadian middle school. 46 participants (age $M$ = 10 years) were recruited from two classes. It is unclear whether participant assignment and subsequent attrition (seven students' withdrawn) was equally distributed, or why the selected classes/ school were chosen. Participants were taught four-of-eight unfamiliar English words (e.g., gregarious). Within each class, all participants completed both massed and spaced learning conditions. The massed condition consisted of two sessions separated by <1 minute; the spaced condition entailed two sessions separated by seven days. Sessions across conditions were structured to be identical. Five weeks post-second session, participant learning was assessed. Following the first session, a t-test revealed that the stimuli used in each condition were of equal difficulty (massed mean correct = 61.8%; spaced mean correct = 61.1%) ($t$ (38)= 1.10, $p$ >.05). Similarly, following the first session, performance across the two classes was similar ($t$ <1) therefore Sobel et al (2011) conflated data across the two classes. Following the second assessment, a paired sample t-test revealed that definitions of unfamiliar words were recalled significantly more accurately following spaced practice ($t$ (38)= 3.0, $p$ = .004, $d$ = 0.48).

Vlach and Sandhofer (2012) investigated effects of practice distribution on knowledge acquisition of basic and complex science concepts across 40 primary school children. Participants were randomly assigned to either: massed, clumped, or spaced learning conditions. The massed condition consisted of four lessons in immediate succession; clumped condition consisted of two lessons in immediate succession on one day and the same on the next day; spaced condition involved one lesson per day for four consecutive days. Vlach and Sandhofer (2012) state that 'the only difference between conditions was the lesson schedule' (p. 1139). Four participants’ data was omitted as they did not complete all learning sessions (condition(s) unknown). All participants completed a pre- and post-test assessment, the latter being immediately following the final session. Pre-test scores did not significantly differ across conditions. ANOVA revealed a significant main effect of practice distribution on basic ($F$ (2, 33)= 3.271, $p$ = .05, $\eta_p^2$ = .17) and complex concepts ($F$ (2, 33)= 15.097, $p$ < .001, $\eta_p^2$ = .48). Planned comparison t-tests revealed that across both concept types spaced learning participants knowledge acquisition improved to a significantly greater extent than massed condition participants ($p$s < .05). Significant differences between the spaced and clumped learning condition were revealed for complex concepts only ($p$ < .01). Notably, Pashler, Rohrer, Cepeda and Carpenter (2007) argue that spaced learning may be difficult for teachers to implement in practice due to external influences (e.g., curricula and timetabling pressures).

### 6.4.3 Metacognition.

*‘Teaching students how to monitor their own academic development will enhance attainment’*

*‘Increasing students' awareness of different learning strategies will enhance achievement’*

For Veenman, Van Hout-Wolters, and Afflerbach (2006), metacognition represents one’s awareness, knowledge, and regulation, of cognitive processes during learning activities. Several terms have become increasingly associated with metacognition including self-regulation, learning about learning, and higher-order skills, resulting in inconsistency amongst researchers about their relationship with metacognition. For example, Winne (1996) discusses conflicting perspectives about whether self-regulation is sub-ordinate or super-ordinate to metacognition. As the concept of metacognition seems to lack coherence, Veenman et al’s (2006) relatively loose definition previously offered was adopted.

The EEF Toolkit (2018), Hattie (2009), and Winne and Nesbit (2010) each promote development of metacognitive strategies to raise student achievement. Following a synthesis of 63 studies (number of effects = 143) across two meta-analyses, Hattie (2009) provides a substantial mean effect size ($d$ = 0.72). Based on substantial weighted mean effect sizes ($d$ = 0.62 – 0.71) across seven meta-analyses of experimental research, EEF Toolkit (2018) provides an equally encouraging account stating that metacognitive strategies provide 'high levels of impact, with pupils making an average of eight months' additional progress'. Winne and Nesbit (2010) also cite promise based on three meta-analyses, however, they also cite some concern about the use of self-report measures (e.g., social desirability bias) to assess achievement. Aligning with the imposed inclusion criteria, only research utilising objective measures of achievement will be considered.

According to Veenman et al (2006), effective metacognitive interventions share three fundamental principles. Firstly, metacognitive instruction is embedded into the subject content in focus. Secondly, the value of developing metacognition should be made to students explicitly to encourage active engagement. The final principle, self-regulation, centres on extending metacognitive instruction in hope that students will continue to apply learnt strategies throughout future learning.

The first meta-analysis to be discussed is cited by Hattie (2009), EEF Toolkit (2018), and Winne and Nesbit (2010). Haller, Child, Walberg (1988) synthesised 20 studies ($n$ = 1553) conducted between 1975 - 1986 investigating the impact of metacognitive instruction on reading ability. Included studies were conducted in primary or secondary schools, compared experimental groups subjected to metacognitive intervention against control groups, and provided sufficient data to calculate effect sizes. Of the included investigations, Duffy et al (1987) warrants mention as the experimental group provided an anomalously high effect size ($d$ = 4.80). As Haller et al (1988) note, observed differences may have been confounded as the experimental group received their assessment-type annually whereas the control group had not previously experienced their assessment-type. Haller et al (1988) dealt with this by 'winsorizing' the reported effect size to the next observed largest ($d$ = 3.80).

Overall, Haller et al (1988) report a substantial mean effect size ($d$ = 0.72) with 87% of the included 115 comparisons favouring metacognitive instruction. Substantially larger effect sizes were observed for senior school students compared to primary school-aged children. No significant differences were observed between studies using standardised and researcher-created assessments. Paris, Cross, and Lipson (1984) earlier criticised standardised reading assessments for ‘measuring general aptitude or intelligence more than specific cognitive skills used to aid comprehension’ (p. 1249), thereby suggesting that they may lack internal validity.

The EEF Toolkit (2018) also cites Higgins, Hall, Baumfield, and Moseley’s (2005) meta-analysis. Twenty-nine studies conducted across various countries (UK = 7) met the following inclusion criteria: conducted in a compulsory school setting (secondary school $n$ = 20), utilised objective achievement measure, provide sufficient data to compute effect size, include control group comparison, and participant sample size of >10. Generally, participant sample sizes ranged between 101-500 ($n$ = 13) and 11-50 ($n$ = 11) and employed random participant to condition allocation ($n$ = 13). Those which did not randomly allocate either: randomly assigned pre-existing cohorts to conditions or matched participants across conditions using pre-test scores. Higgins et al (2005) report a substantial overall effect size ($g$ = 0.62) but acknowledge several limitations. Firstly, due to the relatively small number of investigations included, no discussion is provided about whether participant age, educational setting, or intervention duration impacted the effectiveness of metacognitive strategies. Secondly, Higgins et al (2005) criticise included researchers for failing to provide sufficient detail about either the principles or implementation of interventions with many ‘reporting a more general thinking skills approach’ (p. 34). Consequently, it becomes difficult for teachers to identify recurring features of effective metacognitive instruction strategies incorporate research-based interventions into their practice.

Michalsky, Mevarech, and Haibi (2009) conducted a quasi-experiment investigating effects of metacognitive strategies before, during, and immediately after reading a scientific text on student science achievement. 108 Israeli students (age $M$ = 9.5 years) from four randomly selected science cohorts within four randomly selected schools (from a pool of 15) participated. Four teachers each blind to the study aims and randomly selected from a pool of 10 enrolled in a CPD programme before being randomly assigned to lead a cohort. Each of the four conditions (three experimental, one control) were randomly assigned one pre-formed class. All participants studied the same content three-times weekly over the same 12-week period, followed the same lesson structures and received the learning time. To ensure treatment fidelity, a researcher observed each condition weekly throughout the experiment. All students completed pre- and post-tests assessing domain-specific knowledge and science literacy. The domain-specific a 22-item standardised assessment; science literacy was measured using a 15-item researcher-created assessment. Both assessments revealed acceptable reliability at pre- and post-test (all $a > .70$) across two judges.

MANOVA with post-test performance on both assessments as dependent variables were conducted followed by post-hoc analyses. For domain-specific knowledge, no significant pre-test differences were identified ($p = .17$), however significant post-test main effects were observed for time ($F$ (1, 103) = 123.12, $p$ <.001, $\eta^2 = .37$), and time x condition interaction ($F$ (1, 103) = 31.22, $p$ <.001, $\eta^2$ = .13). The main effect of time reveals that domain-specific knowledge was improved across all conditions post-test., however, the significant interaction reveals that there was a significant post-test difference between conditions. Post hoc analyses revealed that metacognitive instruction in each of the three groups resulted in statistically significantly increased performance above the control condition (all $p$s < .05) with high effect sizes ($d = 0.68$, $d = 0.79$, and $d = 1.51$). Similarly, for scientific literacy no statistically significant pre-test differences were revealed between groups and significant post-test main effects were observed for both time ($F$ (1, 103) = 137.34, $p$ <.001, $\eta^2 = .47$), and a time × condition interaction ($F$ (1, 103) = 42.56, $p$ <.001, $\eta^2 = .24$). Post-hoc analyses again revealed that metacognitive instruction resulted in significantly increased performance above the control condition (all $p$s < .05) with mixed effect sizes ($d = 0.77$, $d = 0.19$, $d = 1.77$). Beyond the experimental research discussed, a wealth of correlational research also demonstrates a strong relationship between student metacognition and achievement (see Donker et al (2014) for a comprehensive review).

### 6.4.4 Assessment.

*'Providing feedback following formative assessment is important to raise student achievement'*

*'Testing student knowledge of a topic prior to teaching will raise achievement more than providing reading material'*

The usefulness of feedback following formative and summative assessment is largely uncontested as being an effective approach to raising achievement. Here, feedback is defined as 'information provided by a teacher to a student about the learner's performance relative to learning outcomes' (EEF Toolkit, 2018). Based on a 'substantial number of reviews and meta-analyses', EEF Toolkit (2018) reports that the provision of feedback can result in an additional eight months progress. Based on 23 meta analyses ($k$ = 1287), Hattie (2009) reports feedback to be amongst the most influential contributions teachers can make to student achievement with a strong effect size ($d$ = 0.73). Dean et al (2012) and Didau (2012) further advocates the 'power' of feedback with the former providing an overall effect size ($d$ = 0.76) similar to Hattie's (2009) based on a further meta meta-analysis.

Usually, feedback is provided following a period of learning and subsequent assessment. However, Didau (2012) and Dean et al (2012) highlight how assessing student knowledge of a given topic before study (i.e., pre-testing) also improves learning of related information. Theoretical mechanisms underpinning the pre-testing effect remain unclear, but Little and Bjork (2011) provide two potential explanations. Firstly, pre-testing may increase student interest in the topic thus encouraging more active involvement in subsequent learning. Alternatively, pre-testing may help students in discerning which information or the type of information they are likely to be subsequently assessed on.

Willson and Putnam (1982) conducted a meta-analysis of 32 (number of effects = 134) randomised experiments investigating the impact of pre-testing and feedback on subsequent assessment performance. Participant ages varied; 15 studies involved adult samples, two studies recruited pre-school participants, and the remainder involved school-aged learners. Analysis revealed that experimental (i.e., pre-test) conditions significantly outperformed control groups post-test (*F* = 30.31, $p < .05$). Using Glass' (Δ) effect sizes, a moderate mean effect size (Δ = 0.43) was revealed and 81% of observed effects favoured experimental groups. That finding largely reinforces earlier pre-test syntheses (e.g., Jaeger, 1975; Samuels, 1969). Substantially larger effects were observed with delays between pre- and post-test of between 1-4 weeks (Δ = 4.06) compared to delays of days (Δ = 0.17) and hours (Δ = 0.28). Neither year of publication (earliest study conducted 1959) or sample size were statistically related to effect size. Willson and Putnam (1982) fail to provide either individual study sample sizes or schedules between pre- and post-tests.

Richland, Kornell, and Kao (2009) recruited 63 undergraduate students to investigate the impact of pre-testing on post-study assessment achievement. All conditions required participants to read a scientific passage in an 'unstructured reading situation' (p. 245) designed to reflect usual independent study. The adopted passage was selected because it was considered both academically relevant to, and pitched at an appropriate technical level for, the recruited sample. Zero participants reported being familiar with the passage. Participants were randomly assigned to condition. In the experimental condition, participants completed a pre-test (i.e., tested on the passage content before reading it). In the control condition ($n = 27$), participants were given two extra minutes to read the passage (rather than completing a pre-test). Two counterbalanced pre-tests were created and experimental participants were randomly administered one of the two. Immediately following the permitted text study periods, participants in both conditions completed a post-test. An independent samples t-test comparing mean post-test performance revealed that experimental participants performed significantly better than those in the control condition ($t(61) = 4.26$, $p < .001$, $d = 1.1$).

In a further experiment, Richland et al (2009) employed an identical procedure except the post-test was delayed by one week. 158 undergraduates were randomly assigned to condition (experimental $n = 79$) and the same study materials as discussed previously were used. Again, experimental participants performed significantly better post-test than the control condition (t (156) = 2.8, $p <$ .01, $d$ = 0.45). Here, Richland et al (2009) provide evidence that pre-tests with feedback can effectively raise student achievement when compared against additional study time and these effects persisted following a one-week delay.

Potts and Shanks (2014) conducted three separate within-participant experiments investigating effectiveness of pre-testing for learning definitions of unusual English words (experiment 1) or translating foreign vocabulary (Experiment 2A & 2B). 24 participants completed experiment 1 encompassing 60 pairs of unusual English words (e.g., frampold) with corresponding one-word definitions (e.g., quarrelsome). Words were counter-balanced in pre- and post-tests, and matched by average number of syllables to reduce risks of variables (e.g., word complexity) confounding analysis. The pre-test involved each unusual word being presented randomly in one of the two conditions. The control condition displayed the unusual word and corresponding definition. The experimental condition displayed the unusual word and asked participants to provide a one-word definition before the correct one-word definition was presented. At post-test, all words were presented individually in random order and participants were asked to select the correct definition from four choices. At pre-test, correct responses in the experimental condition were rare ($M$ = 6.5%), confirming that most unusual words were unknown. At post-test, word-definition pairs presented in the experimental condition were recalled significantly more accurately than from the control condition ($t$ (23) = 3.65, $p$ = .001, $d$ = 0.47).

Potts and Shanks (2014) later replicated their study using 30 participants and replacing words correctly identified in the pre-test. In the experimental pre-test, 0.3% of responses were correct. In the post-test, their previous findings were replicated as words presented in the experimental condition were correctly identified significantly more regularly than from the control condition ($t$ (29) = 4.27, $p$ = .001, $d$ = 0.40). These experiments provide evidence that pre-testing is a more effective way of raising student achievement than reading. Essentially, providing a (usually incorrect) response and then receiving feedback led to significantly better post-test performance than reading.

In a series of experiments, Kornell, Hays, and Bjork (2009) further demonstrate the positive impact of pre-testing on student achievement. All experiments followed the same procedure: study/pre-test, delay, and assessment. Twenty-five undergraduate participants completed experiment one in a 2x2 within-participants design with two independent variables: question type (i.e., fictional and non-fictional) and condition (i.e., read-only vs. pre-test). During the initial study/pre-test phase, the 40 questions (20 fictional and 20 nonfictional) were randomly split between the read-only and pre-test conditions. In the read-only condition, question and answer were presented together. In the pre-test condition participants were asked to generate an answer before the correct answer was presented. There was then a five-minute distraction task before the post-study assessment in which participants responded to questions presented in a random order. In the initial phase, zero participants in the pre-test condition responded correctly to a fictional question. In the post-study test, accurate recall was significantly higher for fictional items amongst pre-test participants than read-only participants ($t$ (24) = 2.97, $p$ = .01, $d$ = 0.58). For non-fictional items, participant response accuracy was also higher in the pre-test condition than in the read-only condition, however those differences were not statistically significant ($t$ (24) = 1.20, $p$ = .24, $d$ = 0.27).

In a second experiment, several methodological and ecological flaws were rectified. The prior experiment entailed only a five-minute delay between pre- and post-tests which, although arguably reflects some real-life situations (e.g., last-minute revision), does not reflect the greater amount of time learners usually experience between study and assessment. Secondly, answers to fictional questions were predominantly arbitrary names meaning that it would be almost impossible for a participant to give 'correct' answers. Consequently, any attempt to generalise findings across learning contexts may be limited. The following is an example fictional item: 'Who is the bouncy and egotistical friend of Kenny?". Kenny is a fictional character therefore participants would be unable to retrieve any useful information from pre-existing schemas. In most educational learning situations, this is rarely the case for students starting a new topic. Furthermore, because answers to fictional questions were arbitrary, participants would be unable to process them to any meaningful (i.e., semantic) level.

To combat the cited flaws, 30 undergraduate participants followed the same procedure as previously discussed, except the stimuli used previously was replaced with ‘weak associates’ (e.g., olive – branch, mouse – hole) and the delay was increased to 38 hours. Using the new stimuli, pre-test participants were presented with a cue (e.g., olive) and asked to guess the target (e.g., branch), or they were presented with the cue and target simultaneously in the read-only condition. During the study/ pre-test phase, pre-test participants guessed 4.9% of trials correctly and that stimuli were removed from the post-test. Again, recall accuracy was significantly greater for pre-test participants than read-only participants ($t$ (29) = 5.16, $p$ < .001, $d$ = 0.94). Both Kornell et al’s (2009) investigations provide evidence that pre-testing is an effective method of enhancing student achievement across learning materials and retention periods.

A real-world implication of the cited findings for teachers is that achievement is enhanced further by promoting, and responding to, inaccurate answers with corrective feedback than simply reading. Though the stimuli used was sometimes artificial, the observed effects remained using stimuli reflective of mainstream secondary school learning. Little and Bjork (2016) report that teachers are increasingly using pre-tests, however Potts and Shanks (2014) highlight caution that pre-testing could alienate learners after poor pre-test performance.

#### 6.4.5 Ability Grouping.

(Within-class) *‘Grouping students within classes based on academic achievement is not an effective way to raise achievement’*

(Between-class) *‘Grouping students into classes based on their ability is detrimental to the attainment of low- and mid-achieving students’*

Schools in England predominantly assign students of similar ages to groups based on their perceived academic ability (i.e., ‘ability grouping’). Although incidence rates vary across subjects, Dracup (2014) suggests that ability grouping is particularly prominent across ‘core’ compulsory education subjects (maths = 71%, science 62%, English = 58%). For Slavin (1990), proponents of ability grouping argue that it enables tailor paced instruction leading to optimum learning for all students. Consequently, a teacher need not be concerned about academically stretching high-achievers whilst simultaneously providing additional support for low-achievers. The argument against ability grouping centres on concerns that the groups perceived to be less academically able will be systematically disadvantaged by slower learning environments.

Problematically for this investigation, the most recent empirical research to meet the instated criteria was conducted mid-1970s (i.e., >40 years ago). Consequently, in addition to a research synthesis and individual investigations, a longitudinal study reinforcing earlier experimental findings will be discussed.

Research has consistently failed to find substantial academic benefits of ability grouping for students of any given academic ability. Evidence that ability grouping disadvantages low- and mid- attaining student groups will also be discussed. Those findings are communicated in several of the identified practitioner texts (i.e., Hattie, 2008; EEF Toolkit (2018); Didau, 2015). Hattie (2009) synthesised 300 studies across 14 meta-analysis, reporting a low mean effect size ($d$ = 0.11) with similarly low core subject outcomes (reading $d$ = 0.00, mathematics $d$ = 0.02). The effect of ability grouping across ability levels were small for high ($d$ = 0.14), and negative for mid ($d$ = -0.03) and low ($d$ = -0.09) achieving learners. The EEF Toolkit (2018) and Didau (2015) base their recommendations on several meta-analyses including those to be discussed.

Kulik and Kulik (1982) reviewed 52 investigations of ability grouping efficacy in secondary schools, however caution should be taken as their inclusion criteria lacked rigour (i.e., poor matching techniques and non-randomisation of teachers included). Included studies were conducted in secondary schools, reported measured outcomes, and were `free of crippling methodological flaws' (p. 419). A low mean overall effect size ($d$ = 0.02) was obtained and studies employing random student assignment produced a negative mean effect size ($d$ = –0.01). When the same teachers were used for ability grouped cohorts and heterogenous groups a similarly low mean effect size (d = 0.07) was obtained compared to ($d$ = 0.14) with different teachers. Ability grouping appeared to be slightly more beneficial for students aged 16-18 (*d* = 0.20) than those aged 12-16 (*d* = 0.05) and were close to zero in both maths (*d* = 0.05) and reading (*d* = 0.02).

Slavin's (1990) meta-analysis was arguably more robust with the following methodological criteria: ability grouped classes compared to heterogeneous classes, achievement data taken from standardised or teacher-made assessments, comparable samples (i.e., random assignment or matching procedures), ability grouping intervention >1 semester, and >3 classes in each condition. 29 studies, each carried out in settings akin to secondary school primarily in the USA (*k* = 23*)* met the instated criteria. From the 20 studies facilitating effect size calculation, Slavin (1990) reports a negative overall median effect size (*d* = -0.02), with zero studies providing statistically significant effects. Medians were reported rather than means 'to avoid giving too much weight to outliers' (p. 480). From the randomised or matched experiments where effect sizes could be calculated, a similarly negative median effect size was reported (*d* = -0.06). Ability grouping appeared consistently ineffective across student ages and subject of study. However, 21 of the 29 studies investigated revealed a greater negative impact on low (*d* = -0.80) and mid (*d* = -0.20) achieving learners compared to high achievers (*d* = 0.01). Notably, two studies conducted during the 1920s were included in analysis. Slavin (1990) concluded that the effect of ability grouping on academic attainment was essentially zero, however, it can be detrimental to lower achieving students.

Kulik and Kulik (1992) conducted a second meta-analysis (*k* = 56) and, although claiming to rectify fragile previous criteria, new criteria are not provided. 51 studies measured the effect of ability grouping on 'achievement tests' producing an overall small mean effect size (*d* = 0.03) and 'trivial in virtually every study' (p.74). 36 investigations considered the impact of ability grouping on students of different academic abilities; a small mean effect size (*d* = 0.10) was observed for high achievers, and negative mean effect sizes for mid and low achievers (*d* = -0.01 and *d =* -0.03, respectively).

Mosteller, Light, and Sachs (1996) reported a meta-analysis (*k =* 10; four doctoral theses included) conducted in secondary schools between 1962 - 1974.

Eight focused on maths, English, and/or science and took place over >1 academic year. Student sample sizes ranged between 75 - 600 ($M$ = 264). An overall sample weighted mean effect size of $d$ = 0.00 was reported. For high achievers there was a small positive effect size ($d$ = 0.08), however, for mid and low achieving students the effect size was negative ($d$ = -0.04 & $d$ = -0.06, respectively).

The final investigation for discussion is longitudinal but useful because it shares high contextual relevance to the current investigation. Longitudinal research can be advantageous over experimental research as it can capture trends whereas experimental research can be criticised for providing only a 'snap-shot'. Furthermore, though longitudinal research can less conclusively detect causality (due to reduced control), it can do so without environment manipulation. Ireson, Hallam, and Hurley (2004) investigated the impact of ability grouping on GCSE attainment in English, mathematics, and science across 45 mainstream secondary schools in England over a two-year period. 38 schools, all selected because they represent variations in ability grouping practices and locations partook. Schools' ability grouping practices were evenly distributed, 12 schools used heterogenous ability classes, 13 schools used 'partial' ability grouping, and 13 schools used traditional ability grouping. Data from 6000 students between Year 9 and GCSE examinations were obtained. When prior attainment (Key Stage 2 or 3 levels), gender, socio-economic status, and attendance were statistically controlled, the number of years of ability grouping that a student experienced from Year 7 to Year 11 had little impact on GCSE attainment in mathematics, science or English (-0.13 - 0.12) (one unit is equivalent to one GCSE grade).

The research literature available suggests that ability grouping is an ineffective method of raising achievement, regardless of student ability. Furthermore, ability grouping may be detrimental to the attainment of mid-, and low- achieving learners. Ability grouping may remain prevalent due to either teacher competence and/or political directives. Wiliam and Bartholomew (2004) observed 150 lessons across 6 secondary schools in England using ability grouped and mixed-ability cohorts before concluding that teachers instructing lower ability groups generally had lower student expectations, failed to academically challenge learners, and used a narrower range of teaching strategies than when teaching mixed ability classes.

Political preference towards ability grouping was made explicit in the 1997 White Paper: *Excellence in Schools* (Department for Education and Employment (DfEE)) which stated that: ‘unless a school can demonstrate that it is getting better than expected results through a different approach, we make the presumption that setting [i.e., ability grouping] should be the norm’ (p. 38). More recently, *Schools: Building on Success* (DfEE, 2001) encourages `further increases in the extent of setting within subjects' (p. 51), and Nicky Morgan, former education secretary, stated: “my priority is not selection by ability between schools but setting by ability within schools” (Wintour, 2014). In 2014, government plans to announce compulsory ability grouping across all secondary schools were leaked however, following a ‘social media storm’, the DfE denied the plans (see: Dracup, 2014).

Research investigating the effectiveness of ability grouping on raising student achievement commenced in the early 1900’s often utilising experimental methods. More recently, longitudinal research methods tend to be used, possibly following: a) necessary adaptations to changes across education (e.g., abolition of 11-plus examination), or b) researchers’ increased awareness of intricate relations between ability grouping and classroom instruction strategies, curriculum coverage, and students’ & teachers’ attitudes.

### 6.4.6 Homework.

*‘Homework is effective in raising attainment only if teacher feedback is given’*

*‘More time spent completing homework will enhance achievement’*

Here, homework refers to teacher-directed tasks assigned to students for completion outside of usual lessons. Homework has been the subject of copious amounts of research and there are numerous variables which reportedly moderate its effectiveness (e.g., student age, student vs. parent estimates, student attitudes). For example, Dean et al (2012), Hattie (2009), and the EEF Toolkit (2018) each promote the provision of homework as an effective method of raising achievement for secondary school students, however the evidence for younger students is mixed. Hattie (2009) reports a substantial effect size (*d* = 0.64) for secondary school students; the EEF Toolkit (2018) reinforces that by suggesting homework provides 'on average, five months' additional progress'. Dean et al (2012) promote a positive relationship between time spent completing homework and achievement.

Cooper (1989) reviewed 120 studies to identify recurring features and characteristics which enhance homework effectiveness. Given the age of the studies captured in this review, little weight will be placed on his findings. Secondary school learners given homework outperformed groups not given homework in 75% of investigations using standardised assessment measures. The standardised mean effect sizes varied between *d* = 0.39 - 0.97 and the weighted mean effect was substantial (*d* = 0.60). Similarly positive findings were observed from analysis of 50 correlational investigations examining a relationship between time reportedly spent on homework and achievement with 43 of those highlighting a significant positive correlation (*r* = .26; 95% CI = .25 - .27).

Cooper, Robinson, and Patall (2006) conducted a further synthesis using research conducted between 1983 – 2003. Criteria excluded studies using preschool and post-secondary students. Although Cooper et al (2006) included research designs beyond (quasi-) experimental, their analysis presented the effect of homework separately across research designs therefore summarised findings here will be based purely on those including (quasi-) experimental designs. All (quasi-)experimental investigations revealed positive effects of homework on achievement with strong effect sizes (*d* = 0.39 - 0.97) and the strongest effects generally being seen for secondary school-aged children.

Cooper et al (2006) also addressed the relationship between time spent on homework (based on teacher-, parent-estimate and student report measures) and achievement. While those measures lack objectivity, there are no feasible alternatives. Research investigating this relationship is almost exclusively correlational and, despite contravening the instated criteria, will be discussed as there are few strictly experimental alternatives. Admittedly, inferring cause-and-effect from correlational research is problematic however, evidence to be discussed was admitted because it is: a) the best available, and b) conclusive (see: Cooper

(1990) for more detail). Cooper et al (2006) identified 69 investigations with sample sizes 55 - 58,000 (*M n* = 8,598). 50 studies revealed a statistically significant positive correlation (*r* range = .25 - .65). Unfortunately, effects across primary and secondary school-aged children are not separated, however, Cooper et al (2006) report that the studies utilising primary school children provided substantially less promising findings than secondary school learners. Cooper et al (2006) verified that observed effects were not attributable to publication bias by comparing published against unpublished research findings and revealing no significant differences.

Further illustrating evidence to support the relationship between time spent completing homework and student achievement, Cooper, Lindsay, Nye, and Greathouse (1998) collected survey-based data from students (*n* = 709), parents, and teachers (*n* = 82) across three states in USA concerning time spent completing homework and student achievement. For secondary school-aged students, significant positive relationships were found between the amount of homework students completed and achievement. Using standardised assessment scores, correlations between student achievement and time spent on homework were significant for parent (r (319) = .24, $p < .01$) and teacher estimates (r (358) = .17, $p < .001$).

Using an experimental design, Townsend (1995) demonstrated similar findings when examining the effect of homework on vocabulary acquisition of 60 primary school students two classes over a three-month period. One class was assigned to an experimental (i.e., homework) condition and another served as a control (i.e., no homework) condition, both were taught throughout by the researcher. A teacher created post-test exam of vocabulary knowledge revealed that the experimental condition performed significantly better (*d* = .71). Notably, it is unclear: a) how students were assigned to classes and how classes were assigned to conditions, and b) whether pre-existing differences in academic ability between classes were measured and accounted for.

More recently, Grodner and Rupp (2013) conducted a field experiment with a pre-/post-test design to explore the effects of homework on college student achievement. 423 economics students were randomly assigned into either a homework-required or a homework not-required group for one term. In the homework-required group, students completed 14 homework assignments and had could correct homework following feedback. A 10% homework weighting was incorporated into their final grade, that percentage was selected because it was 'neither too large (causing undue emphasis on homework) nor too small (causing students to ignore it)' (p. 96). Although the homework not-required participants had equal access to set homework assignments, only six percent of them completed 'most' homework assignments compared to >90% of the homework-required condition. Both conditions were instructed by the same teacher and attrition rates were highly similar across conditions (7.06% - 7.16%. Pre-test assessment revealed no significant pre-existing differences in academic ability between conditions thereby verifying that the random assignment was effective. During the investigation all participants completed four assessments. Using average test score as an outcome variable, a regression analysis revealed that homework completion significantly ($p < .01$) improved participant test score (Beta = .05) translating to a 5-6% increase (or two additional correct responses on a 40-item test).

#### 6.4.7 Note-taking.

*'Achievement will be enhanced if students take notes when learning'*

*'Structured note-taking strategies are more effective than unstructured note-taking strategies'*

Note-taking refers to the capturing key ideas for later access. Dean et al (2012) argue that it improves academic achievement because it requires higher-order thinking skills to summarise, sort, analyse, and reflect on information. Based on analysis of seven investigations, they cite a large sample weighted mean effect size ($g$ = 0.90). Hattie (2009) more cautiously reports a still substantial effect size ($d$ = 0.59) based on analysis of 46 effects. For Kobayashi (2005), note-taking can enhance achievement by 'fostering retention and connections of information as seen in the generation effect' (p. 466). The generation effects states that we retain information more effectively when self-generated than provided by others.

Included within Hattie's (2009) was Kobayashi's (2006) 33 study meta-analysis investigating the effect of note-taking on achievement. Kobayashi (2006) reports that 'the majority of them (participating students) were high-school or college students without learning disabilities in Western countries' (p. 474) therefore we can be confident that the participants upon which this analysis is based share similarities with those in focus in this investigation. Inclusion criteria necessitated that studies included 'learning outcome comparison between outcomes for groups that were instructed or allowed to take notes as usual during class' (p. 462). Learning outcomes were defined as knowledge acquisition measured by various assessment-types (e.g., free-recall, multiple-choice). Large mean sample weighted effect sizes were obtained favouring note-taking groups against: a) groups not allowed to take notes (number of effects = 21; $d$ = 0.75; 95% CI = .61 - .89), and b) groups allowed to 'review presented material mentally before a test' (p. 462) (number of effects = 34; $d$ = 0.77; 95% CI = .64 - .90). The observed effects remained robust across students of different academic abilities and ages.

Reed, Rimel, and Hallett (2016) identified that some interventions included by Kobayashi (2005) involved isolated note-taking instruction rather than the effect of sustained note-taking practice. They conducted a further meta-analysis of literature investigating the effect of 'extended note-taking instruction' (p. 310) on student achievement. Nine peer-reviewed investigations conducted worldwide between 1990 - 2014 met inclusion criteria (number of effects = 28). Most studies involved comparison of various structured note-taking (i.e., experimental) groups against control groups given no instruction, on achievement in an 'objective test' (p. 323). Nine of the investigations included involved interventions lasting 5 – 16 weeks with sessions occurring 1–2 times per week, and in all included investigations the researchers provided instruction of note-taking strategies. Analysis revealed a moderate weighted mean effect size ($g$ = 0.54, 95% CI = 0.47 - 0.62). Perhaps allaying some of the concerns cited by teachers in section 3.4.3, each study reportedly 'provided rich description of the treatments that allow for replication' (p. 334) however duration of note-taking intervention was sometime unclear. Zero studies reported whether or how treatment fidelity was maintained.

Included within the discussed meta-analyses was Simbo's (1988) pre-/post-test experiment investigating the effect of different note-taking strategies on geography achievement of 180 students across four randomly selected Nigerian secondary schools. Three of the recruited schools were assigned variations of structured note-taking strategy to implement (experimental conditions) and respective teachers within those schools were given 'instructions... about which note-taking approach to use, (and) how to put it into operation' (p. 379). In the fourth school, students were not given any instruction about whether or how to take notes (control condition). Notably, students in the fourth school may have implemented note-taking strategies that they had learned previously.

At pre-test, no significant differences were observed between the four schools. Post-test achievement was measured using a researcher-created 25-item multiple choice exam. Face and content validity were established through screening with a selection of teachers familiar with the module being delivered. Reliability was verified using the test-retest method across students separate from the investigation ($r$ = .85). At post-test, significant differences were obtained with the three experimental conditions (range $M$ = 28.10 – 35.15) outperforming ($F$ (3, 176) = 14.73; $p$ < .05) the control condition ($M$ = 16.16). Mean post-test scores have been provided because Simbo (1988) failed to provide standard deviations therefore effect sizes cannot be calculated.

Lee et al (2013) similarly investigated the effect of structured note-taking versus unstructured note-taking strategies in science achievement across 110 secondary school students in China. Students were randomly assigned to one of three conditions: strategic note-taking, partial strategic note-taking, and a control group (no note-taking instruction). Students in the experimental conditions received five training sessions including opportunities to practice their assigned note-taking strategy. In the sixth session, participants from all conditions watched a previously unseen 10-minute science video and were encouraged to take notes as instructed in their respective conditions (control condition received no instruction). Participants were then immediately assessed using 15 multiple-choice items and three short-answer essays, both of which demonstrated strong internal consistency

($\alpha$ = .76 and $a$ = .80, respectively). Initial multivariate analysis revealed a significant main effect of condition ($F$ (12, 190) = 3.99, $p$ < .001). Further analysis revealed significant differences across both the multiple-choice ($F$ (2, 100) = 18.88, $p$ < .001) and essay ($F$ (2, 100) = 4.51, $p$ = .01) assessments. Post-hoc pairwise comparisons revealed that the strategic note-taking condition ($d$ = 0.52 and $d$ = 0.41) and partial strategic note-taking condition ($d$ = 0.76 and $d$ = 0.38) statistically significantly (all $ps$ < .05) outperformed the control groups on the multiple-choice and essay assessments, respectively.

#### 6.4.8 Direct Instruction.

*'Providing students with learning objectives before learning will improve student achievement'*

*'Setting challenging but realistic goals for students will raise achievement'*

Winne and Nesbit (2010; p. 668) describe direct instruction as a 'broad domain' characterised by a collective set of teaching practices which tend to be dichotomised against 'discovery learning'. Here, discussion will focus on two intertwined practices performed by teachers at the outset of direct instruction-based learning: stating learning objectives and setting challenging (but realistic) goals.

Dean et al (2012) argue that setting goals (e.g., learning objectives) provides learners with a direction to guide learning thereby enabling a connection between their starting point, what they are learning, and where they should be at the conclusion of the learning period. For Husbands and Pierce (2012) setting learning goals forms one of nine research-based principles that 'make great pedagogy' (p. 6). Within Winne and Nesbit's (2010) discussion, they refer to two reviews which both 'provide ample evidence' (p. 659) that learning goals can increase student achievement. Dean et al (2012) propose that providing learning objectives enhances student achievement by decreasing student anxiety and building student intrinsic motivation. Willingham (2009) is more implicit in promoting goal-setting mentioning its importance no less than 30-times in the context of good teaching practice though not allocating it an exclusive section.

In the first edition of *Classroom Instruction That Works* (Marzano, Pickering, & Pollock, 2003), a moderate overall effect size (*d* = 0.61) was reported. However, that effect size conflates syntheses investigating effects of goal-setting and feedback on achievement. Illustrating how conflating effect sizes across variables can be problematic, Marzano et al (2003) included only three research syntheses investigating 'General effects of setting goals or objectives' (p. 107) on student achievement (number of effects = 49). Each synthesis provided an overall effect size of *d* > 0.40 (range *d* = 0.46 – 1.37) which perhaps appears more promising than the conflated overall effect size previously stated (i.e., *d* = 0.61).

One of the three research syntheses included was Glaser and Burnstein's (2007) quasi-experiment using 113 primary school children studying German across six existing classes in three German elementary schools. Classes were approximately equally sized and randomly assigned to one of three conditions: learning objectives with personalised goals, learning objectives only, and control conditions (i.e., no learning objectives or personalised goals). Pre- and post-tests were administered one week before and three days after instruction, and follow-up tests were administered 5 weeks after post-testing. Instruction was delivered in four 90-minute sessions by research assistants who had developed 'extensive experience in teaching writing skills to elementary school children' (p. 302). They were given two-week intensive training in which they 'received a manual describing in detail the strategies, exercises, materials, and instructions to be taught' and 'were required to model each lesson until they demonstrated a high level of proficiency' (p. 303). Assistants were blind to the research hypothesis and randomly assigned to condition. Treatment integrity was assessed for each session as students' written documents were compared with instructors' protocols. Student performance in each test was measured using a story-writing task and assessed by an experienced teacher of that curriculum. Participant scores across tasks were conflated for analysis.

At pre-test, no significant differences between classes were observed for story grammar or quality. Despite that, Glaser and Burnstein (2007) analysed post-test and follow-up test written task performance using pre-test scores as a covariate within ANCOVA. Effect of condition was significant both at post-test ($F$ (2, 109) = 63.77, $p$ < *.001,* $\eta^2$ = .54), and at follow-up test, ($F$ (2, 109) = 90.78, $p$ < .001, $\eta^2$ = .62). At post-test, learning objective with personalised goals students outperformed students in the learning objectives only condition ($F$ (2, 108) = 21.23, $p$ < *.001),* $d$ = 1.02), who outperformed control students ($F$ (2, 108) = 23.27, $p$ < .001, $d$ = 1.23). At follow-up test, learning objective with personalised goals students received significantly higher scores than learning objective only students ($F$ (2, 106) = 18.10, $p$ < .001, $d$ = 0.87) whose scores did not significantly differ from those in the control condition. At post- and follow-up test the magnitude of the effects reflecting the superiority of the strategy + self-regulation condition was large

Interactions between condition & time were also significant (Wilks's Λ = .42, $F$ (4, 218) = 29.17, $p$ < .001). For each experimental condition, there were significant differences in repeated measures tests. Learning objective with personalised goals students improved from pre- to post-test ($t$ (40) = 11.81, $p$ < .01, $d$ = 0.87) and follow-up test ($t$ (40) = 9.58, $p$ < .01, $d$ = 0.76). Learning objective only students also improved from pre-test to post-test ($t$ (33) = 5.51, $p$ < .01, $d$ = 0.52) but deteriorated at follow-up test ($t$ (33) = −7.21, $p$ < .01,). That investigation entailed strict controls to maintain internal validity and the analyses provide robust evidence that providing learning objectives are an effective way of raising student achievement. Notably, the strict controls (e.g., highly structured sessions) may detract from the ecological validity of their findings.

Further illustrating the effects of goal setting on achievement, Martin and Elliot (2016) conducted a pre-/post-experiment assessing the role of setting challenging (‘personal best’) goals on maths achievement. Eighty-nine elementary and secondary school students from an unstated number of schools in Australia participated. In 2012, each participant completed a standardised 40-item maths assessment ‘widely recognized as a valid and objective measure of mathematics’ (p. 225). They were each four-weeks away from taking equivalent assessment in 2013 when they were randomly assigned to either experimental (challenging goal set) or control (no goal set) conditions.

A t-test revealed no significant differences in 2012 achievement between conditions (t (87) = -.52, $p$ = .60). ANCOVA (2012 test achievement as covariate) revealed that the experimental group's 2013 assessment scores improved to a significantly greater extent than the control condition ($F$ (1, 86) = 10.05, $p$ < .01) with a moderate effect ($d$ = 0.56). No significant differences in academic improvement were observed between participants of different schooling (elementary versus secondary) or gender.

### 6.4.9 Feedback.

*'Students must perceive praise to be sincere for it to positively influence achievement'*

*'Feedback that provides learners with a goal will raise achievement'*

Feedback is an exceptionally broad topic and has received enormous academic attention and perhaps consequently Kluger and DeNisi (1996) report that feedback findings are 'seldom straightforward' (p. 254). However, based on a synthesis of 23 meta-analyses ($k$ = 1,287), Hattie (2009) reports feedback to be 'among the most powerful influencers on achievement' (p. 173) with a strong effect size ($d$ = 0.73). These conclusions appear somewhat contradictory and could conceivably confuse teachers. However, in researchers' defence, unclear communication may be an inevitable implication of conflating vast quantities of research into a single effect size. This is particularly problematic in the case of feedback because of the volume of variables at play (e.g., person vs. task, written vs. verbal). Black and William (1998) cite such difficulties as justification for not incorporating a meta-analysis into their extensive and widely cited (10258 citations according to Google Scholar at the time of writing) review of feedback research.

The current study focuses on two principles of feedback which, according to educational research findings, consistently raise achievement. Both Dean et al (2012) and Willingham (2009) promote sincere teacher praise with the former arguing that it can enhance achievement by improving student socio-emotional factors (e.g., intrinsic motivation, self-efficacy) and the latter arguing that insincere praise can be 'destructive' (p. 142) to student achievement. Positive relationships between socioemotional and student achievement have been reported quite consistently (e.g., Phan, 2010).

Henderlong and Lepper (2002) further endorse sincerity as a ‘necessary condition’ (p. 776) in acquiring positive academic consequences of teacher praise. As with most literature in this field, they build conceptual links between praise and achievement through the proxy of intrinsic motivation. Brophy’s (1981) literature review investigated the effect of various characteristics of teacher praise (e.g., sincerity) on several classroom variables including student achievement. Sincere praise was defined as that which ‘sounds credible. Among other things, this means that the content will be varied according to the situation and the preferences of the student being praised’ (p. 12). Consideration of student preferences poses methodological problems likely forcing researchers to recruit students’ regular teachers because only they would have a sufficient rapport to appreciate student preferences. Using regular teachers within investigations is potentially problematic in maintaining treatment fidelity because teachers must understand conceptual and practical dimensions of an intervention to implement it effectively. Without said knowledge, the intervention may not be implemented systematically thereby compromising internal validity.

Brophy (1981) fails to provide study inclusion criteria or statistical data to support conclusions and most included research was conducted during the 1950’s (based on his reference list). Consequently, his synthesis will be discussed only briefly. Whilst concerns about contextual relevance to the present day are noted, findings differ little from those more recent. Based on ‘several’ studies in primary school settings conducted during the 1970’s, Brophy (1981) reports that praise administered following ‘good answers or good work’ (p. 16) enhanced the motivation of leaners according to student reports and resulted in them performing better in subsequent set activities. However, when praise was given regardless of work quality then positive effects reportedly diminished.

Sarafino et al (1982) used an experimental design to demonstrate the impact of sincere praise on the achievement of a primary school cohort ($n$ = 32) in USA. Over two phases split equally one-week apart, students completed eight academic riddles. Participants were split into either 'sincere' or 'insincere' verbal praise conditions and the respective praise was administered during both phases. Sarafino et al (1982) do not provide specific information about the language and opportunities which provoked sincere and insincere praise. However, the type of verbal praise given was reportedly the only difference between conditions and experimenters were reportedly given training about opportunities to deliver praise along with scripts. Prior to the first phase, participants completed a separate series of riddles to identify pre-existing differences in ability. No significant pre-existing differences were obtained between conditions ($t$ (33) = 0.84, $p$ = .14).

After the first phase, no significant differences were observed in achievement (i.e., number of riddles successfully completed) ($p$ = .20). Significantly more riddles were successfully completed in the second phase by participants in the sincere praise condition than in the insincere condition ($t$ (29) = 2.35, $p$ < .05; $d$ = 0.53). Participants were then given the option to complete further riddles and, again, a significantly greater proportion of sincere praise condition participants opted to continue with the task than insincere condition participants ($t$ (29) = 3.14, $p$ < .01; $d$ = 0.68).

Hancock (2002) further demonstrated the positive impact of sincere praise on 54 college students in USA. Admittedly, research utilising college participants is beyond the instated criteria. However, this investigation is one of few which is well-designed and includes an appropriate control condition. Participants were placed in one of two conditions, both of which were delivered by the same instructor for 16 weeks and shared session schedules, content, and learning objectives. All participants were asked to complete a homework log during the experiment and submit it to the instructor on several occasions throughout the investigation.

Participants in the control condition received no praise regardless of how many hours homework were reported. In the experimental condition students reporting >3 hours homework received verbal praise (e.g., 'great work' (p. 88). Participants could not be randomly assigned to condition therefore they were matched across several social (e.g., gender) and academic (grade-point average) variables. Achievement was measured during the final session using an instructor-created test administered to both conditions. Content validity was established through verification from two experts and a moderate split-half reliability coefficient of 0.76 was obtained. Analysis revealed that the control condition scored (*M* = 81.86%) significantly lower on the assessment than the experimental condition (*M* = 85.11%) ($t$ (52) = 2.065, $p$ = 0.04; $d$ = 0.54). Hancock (2010) also measured student intrinsic motivation towards the learning module using a standardised self-report scale. Though pre-existing student motivation was not measured, the theoretical proposition that sincere verbal praise can positively influence intrinsic motivation was somewhat reinforced as control condition participants reported significantly lower motivation than the experimental condition ($t$ (52) = 2.170, $p$ = 0.03; $d$ = 0.56).

Progressing to the second principle in discussion, Husbands and Pearce (2012) endorse assessment for learning as a characteristic of 'highly successful pedagogies' (p. 2) and within their discussion promote feedback which 'allows them [i.e., students] to track performance against goals so that adjustments in effort, direction and even strategy can be made as needed' (p. 10). Hattie and Timperley (2007) reinforce the effectiveness of goal-orientated feedback in their synthesis providing a moderate overall effect size ($d$ = 0.46) based on eight meta-analyses ($k$ = 640). They later propose a model of feedback in which goal-orientation plays an instrumental role in the 'three major questions' which 'effective feedback must answer' (p. 87): 'Where am I going? (What are the goals?), How am I going? (What progress is being made?), and Where to next? (What is needed to make better progress?)' (p.88). A similar message was communicated earlier by Black and William (1998) though, as previously mentioned, they did not meta-analyse research hence effect sizes are absent. Those 'major questions' appear to have found traction within practitioner texts, as they are promoted by Willingham (2009), Dean et al (2012), and within the EEF Toolkit (2018).

The effects of goal-orientated feedback were demonstrated by Butler (1987, 1988) in two similar experiments. Butler (1987) randomly recruited 16 classes from four primary schools in Israel. Each class was randomly assigned to a condition. All pupils participated throughout however, only 50 participants' data from each condition was analysed (i.e., those whose prior achievement fell in the top and bottom 25% across maths and language). This experiment entailed three two-hour sessions in which instructions across conditions were reportedly identical. Sessions one and three consisted of 'divergent thinking' tasks [further detail is absent] of similar difficulty as verified during a pilot study. Session two entailed a similar filler task to 'reduce boredom and practice effects' (p. 476). Following sessions one and two, students submitted their work and received one of four types of written feedback. The Comments condition received 'one sentence, which included a goal-setting component and related specifically to the performance of the individual' (p. 476). There were also a Grades-only condition, Praise (e.g., 'very good') condition, and a No feedback condition.

Analysis was based on tasks from sessions one and three only. A two-way ANOVA (condition and prior achievement as IV's) with session one task performance as the outcome measure yielded a significant main effect only for school achievement ($F$ (1, 192) = 174.9, $p$ < .001) confirming that high prior achievement students outperformed lower prior achievement students. ANOVA for session three revealed a significant main effect for condition ($F$ (3, 192) = 72.49, $p$ < .001) with Comments condition participants achieving the highest scores across each level of achievement. Butler (1987) failed to provide post-hoc (or equivalent) tests, however, even the smallest differences for students with high prior achievement which lay between the Comments and Grade-only conditions revealed a large effect size ($d$ = 1.79) thereby suggesting that the difference was meaningful. As sample sizes across conditions remained consistent then we can be confident that the magnitude of difference between the Comments condition and the other conditions would be greater.

Though relevant to secondary education learning, Butler's (1987) analysis and conclusions were based upon a single task-type. Butler (1988) developed her earlier findings in a second experiment using a highly similar methodology and, as such, only aspects which differ will be discussed. Butler (1988) randomly selected 12 whole classes from four secondary schools. Analysis was limited on the same basis as discussed previously resulting in data from 24 high-achieving and 24 low-achieving learners being analysed. The procedure was as previously described; however, participants instead completed a convergent (task A) followed by a divergent (task b) written activity in each session. Following each session, students submitted their work before receiving one of three types of written feedback. The Comments and Grade-only conditions were as previously described, however, there was also a Comments + grades condition.

Scores on work completed in each session served as outcome measures. Following the first session significant differences were observed for both task A ($F$ (1, 25) = 13.02, $p$ <.01) and task B ($F$ (1, 25) = 6.01, $p$ <.05) with high achieving students performing significantly better in both thereby providing some reassurance of that experimental tasks were relevant to those completed in schools. Hereon only analysis of low achieving students will be provided for brevity, however findings for high achieving students were very similar. Following session two, a significant main effect of feedback condition was revealed for tasks A ($F$ (1, 125) = 5.84, $p$ < .05) and B ($F$ (1, 125) = 17.67, $p$ <.001). Planned comparisons revealed that Comments condition participants scored significantly higher (both *p*s <.05) than the Grades-only ($d$ = 0.56) or Comments + grades ($d$ = 0.64) conditions. Following session three, a significant main effect of feedback condition was again revealed for task A ($F$ (2, 125) = 29.60, $p$ <.001) and task B ($F$ (1, 125) = 44.36, $p$ <.001). Planned comparisons revealed that participants in the Comments condition scored significantly higher ($p$ <.01) than those from the Grades-only condition ($d$ = 0.81) and higher (though not significantly) than the Comments + grades condition.

Essentially, participants receiving goal-orientated comments performed better when compared against peers of similar academic ability who received either Grades-only or Comments + grades. Interestingly, participants receiving Comments + grades performed almost consistently worse which Butler (1988) attributed to negative undermining effects of grades. Notably, this experiment arguably lacks ecological validity because the tasks administered were ‘not part of normal curriculum work’ (p. 11).

### 6.4.10 Practice.

*'Students' retention of learned material will be enhanced by practising it'*

*'Allowing students to practice will increase the transferability of those skills to new situations'*

Willingham (2009) and Didau (2015) endorse both principles mentioned above. For Willingham (2009), the first principle is 'self-evident and not very controversial' (p. 82) and he illustrates it through several anecdotes. For example, when learning multiplication strategies students are generally taught them and then encouraged to practice applying them to different multiplication problems. Didau (2015; p. 235) propose that 'studying material once and testing three times will result in approximately 80% improved retention' over vice-versa. The notion that practice will improve retention is long-standing; within their literature review Roediger and Butler (2011) trace it back to Bacon's (1620; as cited in Roediger & Butler, 2011) discussion of repeat testing. Testing provides practice opportunities and better enhances both short- and long-term retention of learned material than increased exposure (usually in the form of studying).

Despite substantial empirical evidence, 'theoretical understanding – or even proper theories of the effect – have lagged behind' (Roediger & Butler, 2011; p. 24). One prominent theory posits that practice facilitates both re-exposure and 'overlearning' of material (Slamecka & Katsaiti, 1988), however, several investigations (e.g., Glover, 1989) have provided opposing evidence. Pyc and Rawson (2009) discuss inconsistent evidence for a related theory of 'retrieval effort' in which the idea is that effort required in retrieving material is closely linked to retention potential.

Willingham (2009) points to Bahrick and Hall's (1991) experiment in which 1726 participants aged between 19 - 84 years from the USA completed an algebra assessment and were compared against control groups who had not studied algebra. The created assessment consisted of unchanged aspects of high-school mathematics curriculum between 1937 – 1986. It was piloted with 92 participants who largely represented the final sample and reliability was verified (Spearman-Brown coefficient = .94). The assessment identified: a) original learning, b) subsequent practice activities, and c) retention interval duration. The extent to which practice occurred during the retention period was estimated based on relevant academic courses completed and the duration and recency of other declared practice activities. Hierarchical regression revealed practice to be a significant predictor of retention ($F$ (2, 820) = 9.53; $p$ = .001) explaining 69.22% of variation in algebra scores. Bahrick and Hall (1991) conclude that retention was largely unaffected by individual difference variables (e.g., aptitude, achievement) and 'much more influenced' (p. 31) by variables pertaining to practice.

Karpicke and Roediger (2008) investigated whether retention of learned information after one-week is better improved through repeated encoding (i.e., exposure) or practice (i.e., assessment). Secondary school-aged students in USA learned 40 Swahili-English word pairs (e.g., mashua-boat) before being placed into one of four conditions which differed by procedure once they correctly recalled a word pair. Conditions one and two were similar; participants tested on all word pairs in each test period. Conditions three and four were also similar; participants were not tested on pairs once recalled accurately but were exposed to them. Karpicke and Roediger (2008; p. 967) report that 'performance was virtually perfect by the end of learning (i.e., all 40 English target words were recalled by nearly all subjects)'. At the end of the learning phase, students were dismissed and returned for testing one-week later. Analysis demonstrated that testing, rather than studying, was the critical factor in determining retention. In conditions one and two, participants correctly recalled approximately 80% one-week later whereas recall dropped to 36% and 33% in conditions three and four. Tests of significance are not provided, however, the magnitude of the difference between groups are evident by a high effect size ($d$ = 4.03) favouring conditions one and two (range = 63 – 95%) over conditions three and four (range = 10 – 60%).

Perhaps highly-relevant during the Covid-19 pandemic, Carpenter, Pashler, Wixted, and Vul's (2008) web-based experiment further illustrates the importance of practice. For Carpenter et al (2008), there are 'consistent patterns of results across laboratory and web-based experiments' (p. 440) therefore being web-based should have little influence on validity. 57 secondary-school aged students in the

USA participated, though it is unclear how they were sourced. Stimuli entailed 60 obscure facts (e.g., ‘greyhounds have the best eyesight of any dog’ and a within-participants design was used. In the learning phase, each fact was presented individually and then presented again in either the test/study (i.e., fact presented as a question, participant recalls answer, question and answer then presented simultaneously) or study (i.e., fact presented in question format simultaneously with correct answer) condition. After two days and again at six weeks, participants completed tests using 10 of those facts (five presented in either condition). After two days, ANOVA yielded a significant main effect of condition ($F$ (1, 56) = 47.38; $p < .001$, $\eta_p^2 = .46$) with facts learned through test/study condition retaining an average rate of 78% compared to 70% for the study condition. After six weeks, a main effect of condition was again revealed with an increased effect size ($F$ (5, 280) = 147.51; $p < .001$, $\eta_p^2 = .72$] and facts learned through test/study condition retaining an average rate of 40% compared to 35% for the study condition.

As highlighted by Roediger and Butler (2011), a possible criticism of the previously discussed principle is that retrieval practice may ‘merely teach people to produce a fixed response when given a particular retrieval cue’ (p. 23). Hence, the second principle; practice promotes transfer of knowledge. In other words, practised material can be used flexibly to construct new responses and answer different questions. For Didau (2015), knowledge transfer to new concepts is ‘the grail’ (p.237) amongst educators and is attainable through practice. Barnett and Ceci (2002) earlier highlighted that knowledge transfer has been a topic of interest amongst policy-makers. Some evidence of that can be seen in the *Education Inspection Framework* (Ofsted, 2019) which emphasises the need for teachers to enable ‘integration of new knowledge into larger concepts’ and ‘make enduring connections that foster understanding’ (p. 15). Though not strictly policy, it is likely that Ofsted’s framework has to some extent been influenced by policy-makers.

Butler (2010) investigated whether repeated practice (i.e., testing) produced better transfer of facts and concepts from six passages than repeated exposure (i.e., studying). 48 undergraduate students participated. The within-participant experiment consisted of two sessions spread one week apart. In the initial learning session, participants studied all passages before repeatedly (i.e., three times): studying two passages (restudy condition), taking the same test on another two passages (same test), and taking different tests on the remaining two passages (variable test). In an initial assessment, ANOVAs revealed no significant differences between learning conditions on factual ($F$ (1, 23) = 1.73, $p$ = .20) or conceptual ($F$ < 1) questions. One week later, participants returned for a post-test and were assessed on the extent to which they could transfer information from the six passages to answer 'inferential questions from the same knowledge domain' (p. 1122). ANOVA revealed a main effect of learning condition on factual inferential ($F$ (2, 46) = 16.73, $p$ < .05; $\eta^2$ = .42) and conceptual inferential ($F$ (2, 46) = 15.63, $p$ < .05; $\eta^2$ = .41) questions. For factual inferential questions, planned pairwise comparisons confirmed that both test conditions produced better transfer than the restudy condition (both $p$s < .05; $d$ = 0.93 - 1.03), no significant differences were observed between the two testing conditions (t < 1). A similar pattern followed for the conceptual inferential questions with both test conditions leading to better knowledge transfer than the restudy condition (both $p$s < .05; $d$ = 0.74 - 0.87), and no significant difference between testing conditions were observed ($t$ < 1).

Chen and Klahr (1999) demonstrated children's ability to transfer a 'control of variables' strategy to more distant concepts. Fifty-five primary school-aged children learned how to design basic science experiments and make inferences based on their findings. Participants each completed control of variables 'training' followed by an assessment to identify understanding. Participants were then placed almost equally into one of two experimental conditions both involving several hands-on experiments or a control condition entailing further teacher-led instruction. The differences between experimental conditions were subtle and irrelevant for the purposes of discussion here. All conditions spent the same amount of time on task.

Assessment immediately post-training revealed no significant differences in control of variables strategy knowledge between the three groups ($F < 1$). Seven months later, participants completed an assessment consisting of 15 problems split equally across five domains and they were not instructed of its relationship with the earlier procedure. ANOVA yielded a main effect for condition *(F* (1, 51) = 6.61, $p$ < .05). Post-hoc tests revealed that both experimental conditions outperformed those in the control condition (*p*s < .05, $d$ = 0.47 – 0.66). Another measure of transfer adopted by Chen and Klahr (1999) involved identifying the percentage of 'good reasoners' (i.e., participants providing 13 correct post-test responses) in each condition. An average of 79% of experimental group participants good reasoners compared to 22% of control group participants. Chi-square analysis revealed that the experimental groups (combined) had a significantly greater proportion of good reasoners than the control group ($\chi^2$ (1, $N$ = 55) = 10.78, $p$ < .001).

## 6.5 Summary

This chapter was created to identify a selection of teaching principles that are: a) communicated by practitioner texts as having a positive impact on raising student achievement according to research, and b) have become well-established as a result of consistently positive findings obtained through methodologically robust research. That assertion is maintained based on the substantial quantity and quality of evidence provided supporting the teaching principles discussed. Notably, there are caveats that complicate the extent to which teachers can, and should, implement the cited teaching principles into their practice.

The first group of issues relate to the methodology of discussed research. For example, the task-types and learning stimuli sometimes used (e.g., Sobel et al, 2011; Kornell et al, 2009; Potts & Shanks, 2014) arguably fail to reflect mainstream secondary school curricula. In defence of researchers, particular task-types and learning stimuli may have been implemented on the basis that they will enhance experimental control. However, by adopting those which do not reflect mainstream secondary education, the external validity and ecological validity of research is reduced, and therefore perhaps less useful in guiding teachers' practice. From a conceptual perspective, that problem may reflect an ongoing tension between what constitutes 'robust experimental research' and what is considered good educational practice. In extending that argument, said tension is arguably a fundamental flaw with the proposition that educational research can provide teachers with a formula for ‘what works’ in raising student achievement.

The second methodological issue to be discussed relates to the (in)consistency with which robust measures of treatment fidelity are implemented. It is the researcher’s responsibility to communicate ample information or training to enable those implementing an intervention to do so effectively. However, it is then (most commonly) the task of participating teachers to implement intervention(s) in a given educational context. To do that effectively, teachers must understand the intervention at both a conceptual and practical level. If a teacher is not fully aware of the principles underlying the intervention then they may not implement it in a systematic way. As an aside, that may explain Coldwell et al’s (2017) finding discussed in section 3.4.3, that teachers implementation of research-based knowledge is not always systematic. A consequence of treatment infidelity would be reduced internal validity because the measured outcomes would be the result of a teacher’s interpretation of the concept, rather than that of the researcher. Of further concern, the findings of those investigation may be subsequently published and either inaccurately promote or discourage a particular intervention.

Researchers sometimes attempt to address treatment fidelity concerns by periodically observing those implementing an intervention at random points throughout the investigation. That technique can compromise the external validity of the research because the classroom environment in which the intervention is taking place becomes increasingly removed from that in the ‘real-world’. Furthermore, by adopting that technique researchers also face an increased risk of the ‘Hawthorne effect’ as those implementing the intervention will be aware that they are being observed. Concerns strictly surrounding treatment infidelity could be allayed if the researcher was responsible for implementing intervention(s), however there would then be an increased risk of researcher bias confounding subsequent research findings.

The selected Stage Two criteria were implemented because they enable a methodical and systematic approach to identifying relevant research literature. Largely speaking, the sheer volume of research available enabled compliance with the instated criteria and access to sufficient quantities of research for each teaching principle. However, there were several noted occasions where it was necessary to violate those criteria to ensure that the evidence provided was sufficiently robust to constitute a teaching principle being 'well-established'. For example, in the discussion surrounding ability grouping, it was necessary to draw on evidence provided through longitudinal research due to a lack of (quasi-) experimental research within the previous 40-years. Although justification for the imposed research cut-off period has been provided, the extent to which findings of research within that parameter can, and should, be applied to contemporary educational contexts remains uncertain. The selected research cut-off period required consideration largely due to differences between the political context in which research takes place and that of current education. The political standpoint at a given time can play a large role in dictating the direction and quantity of, as well as methodologies used. As illustrated in *Educational Excellence Everywhere* (DfE, 2016) and discussed in Chapter Two, current policy promotes teachers engaging with comparative, quantitative research and will therefore largely dictate the direction that current educational research takes. In determining a research cut-off period, it was important to acknowledge that historical political agendas will have driven educational researchers in different directions using alternative methodologies, all of which will ultimately impact the robustness and relevance of the available research-base.

# Chapter Seven: Results

This chapter will be separated into three sections: Initial Data Analysis (section 7.1), Main Data Analysis (section 7.2), and Additional Data Analysis (section 7.3), the latter two will each progress in-line with RQ's 2-5. To begin, an overview of the data cleaning process undertaken will be offered. The Initial Data Analysis (section 7.1) will explore: a) the distributions of teacher and school samples and their representative of their respective target populations, and b) initial steps in analysing the reliability and validity of both created surveys. The Main Data Analysis (section 7.2) will provide descriptive statistics from both surveys and explore inferential analyses pertaining to each RQ. The Additional Data Analysis (section 7.3) will build on those inferential statistics by identifying inter-variable relationships.

Data cleaning began by transferring collected data from both surveys from Bristol Online Survey (i.e., where it was collected) to Microsoft Excel where necessary item coding took place. Both survey datasets were then combined and GCSE achievement (i.e., Progress 8 scores) and teacher and school demographics were integrated. Where possible, variables were computed using automated functions to reduce the risk of errors. To maintain anonymity and comply with GDPR, confidential information (e.g., teacher names) was replaced with a number unique to that teacher/school. Within the Teacher Survey dataset, some data appeared to be omitted but these are explained by either: a) the School Survey respondent abstaining from completing the Teacher Survey, or b) zero teachers from that school responding to the Teacher Survey. No systematic missing data was found in either survey dataset. The complete dataset was then transferred to SPSS for further analyses.

## 7.1 Initial Data Analysis

**7.1.1 School sample demographics.** As described in section 5.4, the convenience sampling approach used to recruit schools can result in potential biases. 38 schools completed the School Survey, of which 29 were in the north-west. Analyses took place to identify the extent to which recruited schools were representative of secondary schools across the north-west and nationwide.

Number of students on-roll and percentage of students eFSM within each school were used to measure representativeness of the recruited school sample against the target population across England. According to the DfE (2018), the average number of students in each secondary school in England was 976, in the recruited sample the mean number was similar ($M$ = 976.26; $SD$ = 330.22; 95% CI = 867.72 – 1084.80; range = 453 - 1859). Within recruited schools, a mean of 27.4% students were eFSM ($SD$ = 13.60; 95% CI = 22.94 – 31.89; range = 7.10 – 60.10). Nationwide, only the percentage of students eligible *and claiming* FSM was available ($M$ = 14.12%). For reasons documented below, the latter figure is bound to be lower.

Thirty-five of the 38 participating schools are situated in the north-west which has the third highest proportion of students eligible and claiming FSM at 18% (DfE, 2018). The disparity between the mean percentage of students eFSM in the recruited sample (i.e., 27.4%) and those eligible and claiming FSM across the north-west (i.e., 18%) is explained by Iniesta-Martinez and Evans' (2012) finding that approximately 14% of students eFSM are not claiming. As such, the proportion of students eFSM within the recruited school sample are considered largely representative of those across the north-west. In summary, evidence has been provided across both variables that the recruited school sample is representative of the target population.

Data distributions for variables taken forward for inferential analysis were analysed because their normality could influence the analysis (i.e., parametric vs. non-parametric) conducted. Despite appearing skewed, Shapiro-Wilk's test of homogeneity verified that both school demographic variables discussed above were normally distributed ($p$ > .05). The extent to which data is considered normally distributed is determined by comparing sample scores to a normally distributed set of scores with the same mean and standard deviation.

Robustness of Progress 8 scores for participating schools between 2016 - 2018 was verified through statistically significant ($p$ < .01) Pearson correlations of moderate-to-strong magnitude (*r* = .64 - .79). Progress 8 score means were calculated for each school and cumulatively to provide an indication of GCSE performance (*M* = -.06; *SD* = .37; 95% CI = -.18 - .06; range = -.97 - .73). The average Progress 8 score for state-funded secondary schools across England and the north-west were -0.03 (*SD* = 1.06) and -0.16 (*SD* = 1.08), respectively (DfE, 2017). The standard deviation within the recruited sample is narrower than that nationally and regionally, which suggests that the achievement of participating schools was more clustered. More importantly, both mean statistics are within the 95% CI thereby verifying the representativeness of the recruited sample in terms of achievement. Progress 8 mean scores were taken forward for inferential analysis therefore data distribution was addressed. A Shapiro-Wilk's test verified that they were normally distributed ($p > .05$).

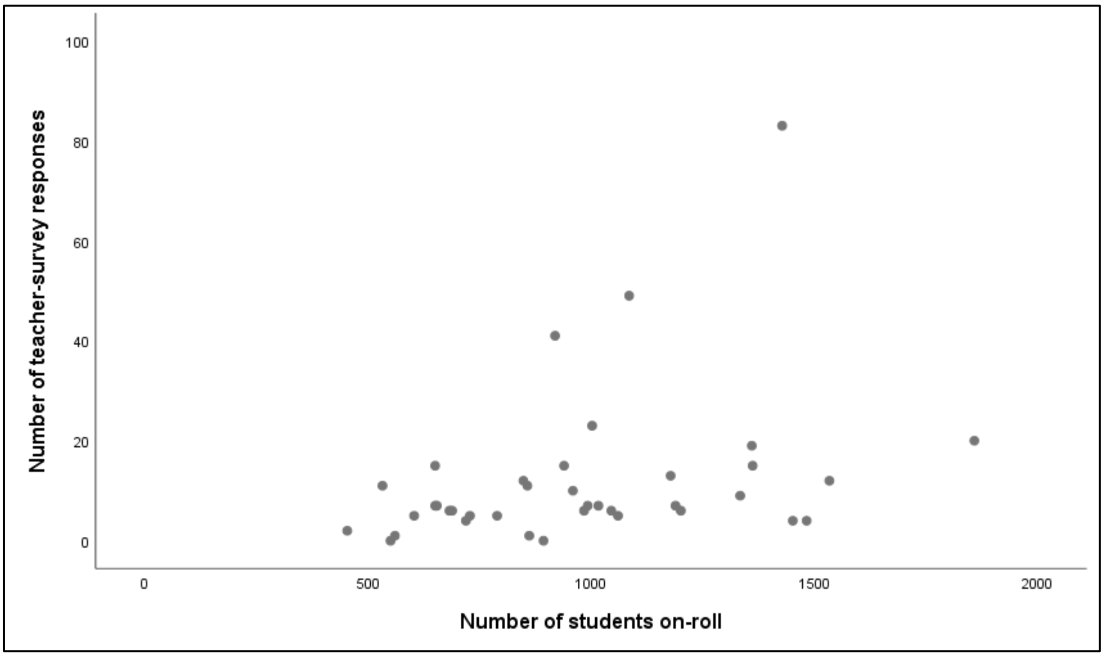
To enable the regression analysis to isolate the influence of data gathered from both surveys and provide a more accurate reflection of their influence, relationships between school demographic variables (i.e., eFSM, numbers on-roll) and Progress 8 mean scores were explored. Pearson's correlations revealed that Progress 8 mean scores significantly negatively correlated with % of students eFSM to a moderate extent ($r = -.59$, $p < .01$). No significant correlations were revealed between Progress 8 mean scores and number of students on-roll.

**7.1.2 Teacher sample demographics.** Professional demographics (i.e., job title, managerial responsibilities, highest academic qualification) of the person responsible for teachers' CPD within each school (i.e., School Survey respondents) were also analysed (Appendix 5). Problematically, data was not available for those responsible for teachers' professional development nationwide, therefore it was not possible to identify the representativeness of School Survey respondents. Broadly, collected data suggest that the persons responsible for teachers' CPD within participating schools are largely homogenous with respect to job title, managerial responsibilities, and highest academic qualification. Most (87%) reported being SMT and the remaining reported middle-management responsibilities. Slightly more variation was observed in job titles, with the majority being assistant headteacher (61%), followed by deputy headteacher (22%), classroom teachers/ head of department/ head of year (7.3%), and headteacher (9.8%). In terms of highest qualification, most had completed post-graduate study (46.3%), followed by PGCE (34.1%), undergraduate degree (12.2%), and PhD (7.3%).

425 teachers from 36 of the recruited schools completed the Teacher Survey. To identify the representativeness of recruited teachers against the target population, the following demographics were obtained from both groups: age, highest qualification, number of years teaching experience, job title, subject specialism (Appendix 6). Some national teacher demographics could not be obtained (e.g., job titles). A series of Chi-square tests revealed zero statistically significant differences between any measured demographic of the teacher sample against the target population indicating that the sample was representative of teachers nationally.

High variation was observed in the number of responses between schools ($M$ = 11.50; $SD$ = 14.28; range = 1 – 83). However, that is explained by the modest significant positive correlation between the number of students on-roll at each school and the number of responses received ($r$ (36) = .34, $p$ = .04) (see Figure 7.1 for scatterplot). Schools with more students would likely provide more responses because they likely have more teachers. Figure 7.1 illustrates four outliers, the clearest being School 5 which provided 83 Teacher Survey responses. When removed from analysis, a moderate but non-significant correlation remained ($r$ (30) = .24, $p$ = .10). Consideration was made of the benefits of weighting Teacher Survey data to ensure a proportionate impact on analyses. A decision was made to not weight data because the correlational analysis above suggests that the disparity in the number of Teacher Survey responses simply represent the teaching population in each school. Additionally, given the magnitude of the difference in responses received from each school, extreme changes to the data would have been required.

Figure 7.1. Relationship between number of students on-roll and Teacher Survey responses from each participating school




**7.1.3 Survey reliability**. Scale reliability for the School Survey was obtained through Cronbach's alpha for homogeneity (i.e., internal consistency) of survey items (*a* = .90) and Spearman-Brown split-half coefficient (.87). Both statistics were taken as evidence that each item within the scale is useful in measuring constructs of a research-informed culture. Ideally, a confirmatory factor analysis would have been conducted, however, the sample size was insufficient.

Data from items 3 – 17 within the School Survey were included in the reliability analysis by creating a third variable. To explain, as discussed in Section 5.3.1 the School Survey entailed 15 items of different formats to identify the steps taken to develop an aspect of a research-informed culture using Cain's (2018) framework. Each of those were supplemented by a 5-point Likert scale supplementary item to identify the extent to which respondents believed that development of the corresponding aspect was important in creating a research-informed culture. Respondent scores for each item and supplementary item were multiplied against each other to create a third variable which was included in the reliability analysis.

For some items, this calculation was complicated therefore a couple of examples will be illustrated. School Survey item 5 provided a list of options and required respondents to 'tick all that apply'. The number of boxes checked was taken as that school's item 5 score, and that was then multiplied by the score obtained in the corresponding supplementary item. The total of that calculation was included in the reliability analysis. In the case of School Survey item 7 (forced-choice), a score of one was obtained for those who reported having a research lead and zero for those that did not. The obtained score was then multiplied by the score reported in the corresponding supplementary item.

Three schools returned two School Survey responses and the inter-rater agreement between them was inconsistent. Within-school agreement was calculated for all School Survey items. Three separate Pearson's Rho correlations revealed statistics between .01 - .56, none of which reached statistical significance. Although three schools are a small sub-sample, agreement inconsistency is a concern for the reliability of Cain's (2018) framework and/or the School Survey. As the remaining schools provided a single response, it was not possible to calculate their within-school agreement.

Within the Teacher Survey: Section One, scale (i.e., items 9 & 10) and multiple-selection (i.e., items 11 & 12) items were presented initially to gauge a participant's perception about a dimension of educational research usefulness and each followed-up with free-text response items for elaboration. For most free-text response items, participant responses largely aligned with findings reported in earlier literature therefore the coding strategy detailed in section 5.3 was effective. Within the Main Data Analysis (section 7.2), data will be cited to evidence that the responses discussed for each item are typical. Descriptive statistics for all School and Teacher survey items are provided in Appendix 7A & 7B, respectively. To reiterate, the Teacher Survey: Section Two was a 26-item assessment created to identify teachers' awareness of well-established, research-based teaching principles. Two parallel versions of the assessment were created; QSA and QSB. 256 completed QSA and 169 completed QSB.

Table 7.1 illustrates large variation in the accuracy of teachers' responses to each item. Participants appeared least familiar with Brain Training 2 (i.e., item 2 within that topic) (30.8% and 16.8% responded accurately to the correct and incorrect versions, respectively) and most familiar with Practice 2 (98% and 93.5% responded accurately correct and incorrect versions, respectively). In the far-right column, all items have been conflated within their respective topics to illustrate the mean percentage of correct responses per topic. Teachers appeared most familiar with Practice items (*M* correct = 91.9%) and least familiar Brain Training items) (*M* correct = 24.5%).

Table 7.1. Number of accurate responses from teachers (% of respondents)

| Topic | Item 1 | | Item 2 | | Topic Mean Correct % |
|---|---|---|---|---|---|
| | Correct Statement | Incorrect Statement | Correct Statement | Incorrect Statement | |
| Ability Grouping | 97 (57.4) | 133 (52) | 156 (60.9) | 113 (66.9) | 59.3 |
| Assessment | 186 (72.7) | 99 (58.6) | 164 (97) | 214 (83.6) | 77.9 |
| Brain Training | 51 (19.9) | 52 (30.8) | 52 (30.8) | 43 (16.8) | 24.5 |
| Direct Instruction | 103 (60.9) | 161 (62.9) | 251 (98.0) | 153 (90.5) | 78.1 |
| Feedback | 241 (94.1) | 88 (52.1) | 157 (92.9) | 231 (90.2) | 82.3 |
| Group Work | 131 (77.5) | 79 (30.9) | 208 (81.3) | 87 (51.5) | 60.3 |
| Hemispheric Differences | 55 (32.4) | 82 (32) | 103 (40.2) | 81 (47.9) | 38.1 |
| Homework | 138 (53.9) | 116 (68.6) | 48 (28.4) | 104 (40.6) | 47.8 |
| Leaning Styles | 86 (33.6) | 64 (37.9) | 39 (23.1) | 84 (32.8) | 31.8 |
| Massed vs. Spaced Practice | 145 (85.8) | 236 (92.2) | 140 (54.7) | 92 (54.4) | 54.6 |
| Metacognition | 154 (91.1) | 211 (82.4) | 190 (74.2) | 121 (71.6) | 86.2 |

| | | | | | |
|---|---|---|---|---|---|
| Note-taking | 117 (69.2) | 197 (77.0) | 197 (77) | 69 (40.8) | 58.9 |
| Practice | 151 (89.3) | 223 (87.1) | 251 (98) | 158 (93.5) | 91.9 |

To determine whether the Teacher Survey: Section Two items was unidimensional and all contributed to the total scale, internal consistency analyses took place revealing Cronbach's alpha α = .43 and α = .43 for QSA and QSB, respectively, thereby suggesting that the assessment may be multi-faceted. To identify the source(s) of lacking homogeneity, corrected item-total correlations (Table 7.2) and inter-item correlations (Appendix 8) were addressed. The former provide insight about the extent to which each item contributes to the total-scale and revealed that within QSA & QSB both Direct Instruction items, both Homework items, Massed Practice 1, Note-taking 1, and Metacognition 2 failed to meaningfully contribute. Before removing items, inter-item relationships were identified using Pearson's correlations (full matrix can be seen in Appendix 8). That analysis provided further evidence that those items failed to contribute to the total-scale as they commonly correlated negatively with other items. Interestingly, in QSB a negative correlation was observed between homework items, suggesting that teachers able to identify one well-established, research-based teaching principle about homework failed to correctly identify the other. This may be evidence that either: a) those items were not constructed correctly, or b) teachers' awareness of some intra-topic research-based knowledge is inconsistent.

To identify whether items could differentiate between teachers, item difficulty was identified using the data illustrated in Table 7.1. Zero items were answered correctly or incorrectly by all respondents thereby suggesting that all items can discriminate between teachers. Items answered correctly by >80% or <20% of participants were considered for removal but only if they also failed to correlate with other items and/or to the construct.

Based on low corrected item-total & inter-item correlations and item difficulty, both Direct Instruction and Homework items, Massed Practice 1, Note-taking 1, and Metacognition 2 were removed and reliability was re-assessed, revealing improved Cronbach's alpha scores (α = .61 & α = .58 for QSA and QSB, respectively). Though below Nunally's (1978) conventional threshold (α = .70) the values obtained are promising given that this measure is original. As highlighted by Taber (2017), alpha alone 'provides limited evidence of a scale's reliability' (p. 2). Split-half reliabilities revealed Spearman-Brown coefficients of α = .67 and α = .65 for QSA and QSB, respectively, reinforcing further improved reliability.

Table 7.2. Assessment item-total correlations (I = incorrect version, C = correct version)

| QSA Item | Corrected Item-Total Correlation (*r*) | QSB Item | Corrected Item-Total Correlation (*r*) |
|---|---|---|---|
| Ability Grouping 1I | .11 | Ability Grouping 1C | .13 |
| Ability Grouping 2C | .12 | Ability Grouping 2I | .17 |
| Assessment 1C | .05 | Assessment 1I | .14 |
| Assessment 2I | .14 | Assessment 2C | .06 |
| Brain Training 1C | .44 | Brain Training 1I | .22 |
| Brain Training 2I | .30 | Brain Training 2C | .16 |
| Direct Instruction 1I | -.14 | Direct Instruction 1C | -.13 |
| Direct Instruction 2C | .02 | Direct Instruction 2I | -.03 |
| Feedback 1C | .13 | Feedback 1I | .27 |
| Feedback 2I | .13 | Feedback 2C | .01 |
| Group work 1I | .16 | Group work 1C | .15 |
| Group work 2C | .13 | Group work 2I | .20 |
| Hemispheric differences 1I | .27 | Hemispheric differences 1C | .10 |
| Hemispheric differences 2C | .26 | Hemispheric differences 2I | .32 |
| Homework 1C | .02 | Homework 1I | .01 |
| Homework 2I | -.12 | Homework 2C | -.22 |
| Learning Styles 1C | .25 | Learning Styles 1I | .37 |
| Learning Styles 2I | .26 | Learning Styles 2C | .13 |

| | | | |
|---|---|---|---|
| Massed vs. spaced practice 1I | .03 | Massed vs. spaced practice 1C | .02 |
| Massed vs. spaced practice 2C | .08 | Massed vs. spaced practice 2I | .27 |
| Metacognition 1I | .15 | Metacognition 1C | .22 |
| Metacognition 2C | -.19 | Metacognition 2I | -.05 |
| Note-taking 1I | .06 | Note-taking 1C | .04 |
| Note-taking 2C | .09 | Note-taking 2I | .16 |
| Practice 1I | .19 | Practice 1C | -.01 |
| Practice 2C | .11 | Practice 2I | .092 |

Exploratory factor analysis was conducted on the remaining 19 items to identify the dimensionality of the construct. An exploratory approach was necessary because therefore there was little available literature to provide a source of comparison. A Principal Component Analysis (PCA) was run to reduce items into meaningful factors by unifying variance from: unique factors (i.e., those which load from a single item), error factors (i.e., those representing unsystematic variance), and meaningful factors. Essentially, the PCA asked: To what extent does teachers' awareness of principles in individual topics (e.g., homework) explain the variance in their collective knowledge of well-established, research-based teaching principles. Upon advice from Adèr (2011), the following three steps were taken in completing PCA: (i) determine the number of meaningful factors, (ii) rotate the factor solution, and (iii) interpret the factor structure. Analyses for QSA and QSB were conducted separately but will discussed simultaneously.

***(i) Find the number of meaningful factors.*** A PCA analysis without rotation was conducted to verify that the data was appropriate for factor analysis and can identify meaningful factors. Significant Bartlett tests of sphericity verified that the data was appropriate for a factor analysis (QSA: $\chi^2$ (171) = 745.83, $p$ <.01; QSB: $\chi^2$ (171) = 372.90, $p$ <.01). Kaiser-Meyer-Olkin's measure of sampling adequacy demonstrated strong relationships among variables across QSA (KMO = .73) and QSB (KMO = .63) further reinforcing factor analysis as an appropriate analytic tool.

To determine the number of meaningful factors, scree plots (Figures 7.2.1 & 7.2.2 for QSA and QSB, respectively) were identified. Based on the length and angle of the eigenvectors, both scree plots suggest that two meaningful factors (or 'components') be extracted. Following identification of prominent factors, eigenvalues for all extracted factors were identified. Several texts (e.g., Dancey & Reidy, 2007, Adèr, 2008) promote a common convention of interpreting factors with eigenvalues >1 to be meaningful (i.e., therefore accounting for more variance than a single item). However, that convention would have resulted in extracting six factors for QSA and eight factors for QSB (see Appendix 9). Zwick and Velicer (1986) earlier reported that convention often overestimates the quantity of meaningful variables because, as is the case here, approximately 1/3 of original components tend to be retained.

Figure 7.2.1. QSA - Scree plot

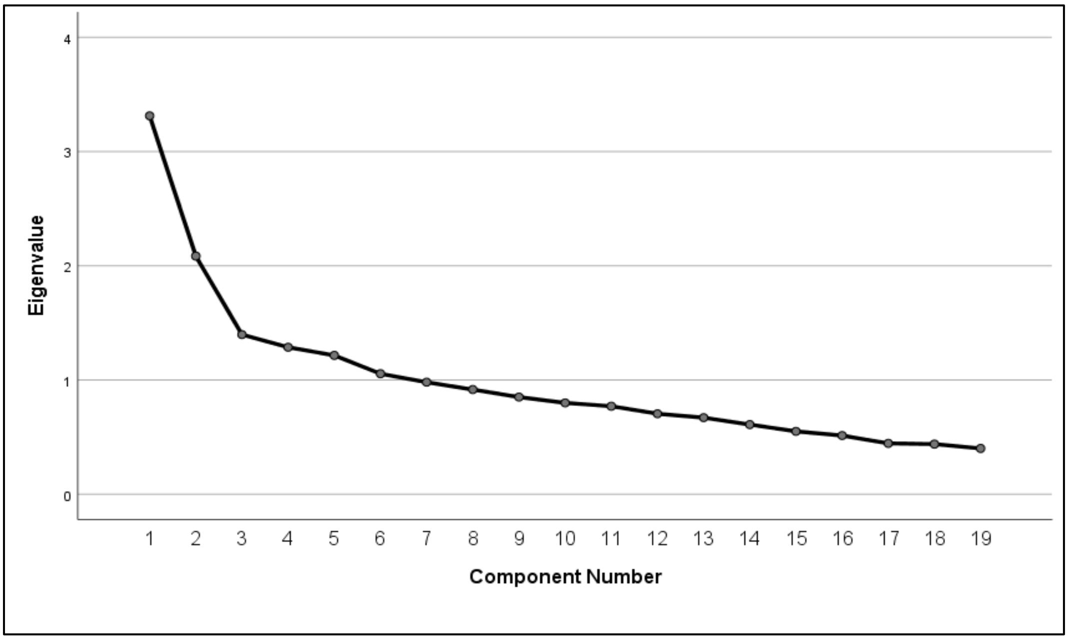
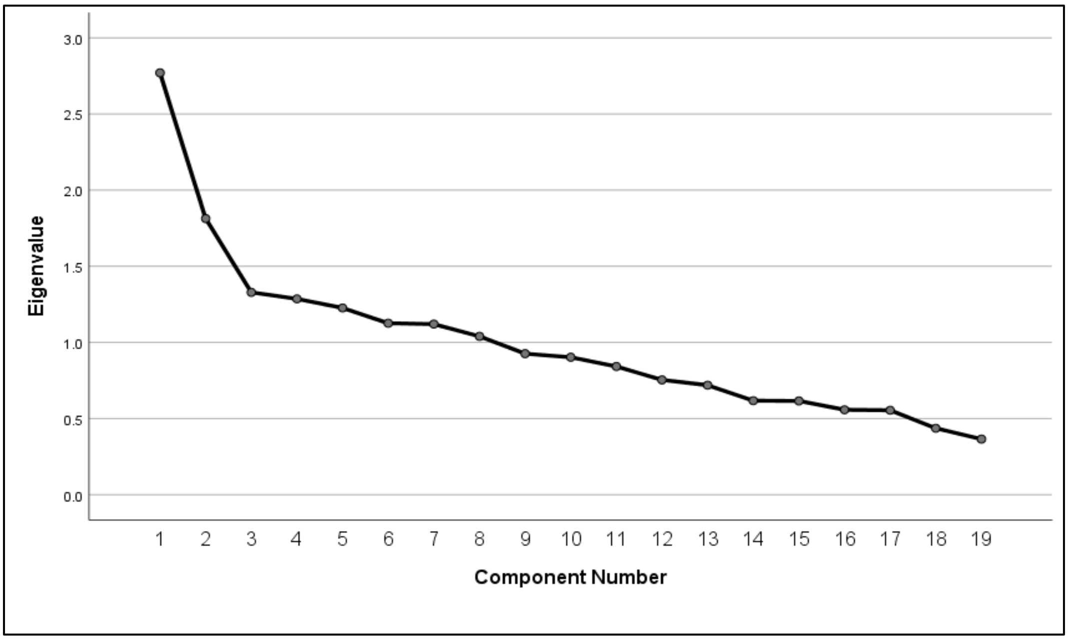


Figure 7.2.2. QSB - Scree plot




Upon further inspection, the six and eight factor models resulted in two factors with zero meaningful item loadings. Factor loadings provide a correlation coefficient between the original item and the factors, therefore offering a gauge of each item's importance in a factor (Field, 2005). Based on the sample size in this investigation, Field (2005) and Adèr (2008) suggest a threshold coefficient of >.35 for a meaningful item loading. Despite only accounting for 28.4% and 24.1% of variance in QSA and QSB, respectively, two factor models were adopted because they provided the most interpretable factor solution.

For QSA, the unrotated two-factor model matrix suggests that all neuromyths load predominantly onto factor one with the addition of Group Work 1. Factor two consisted of meaningful loadings from five items. For QSB, all neuromyths except Hemispheric Differences 1 loaded meaningfully onto factor one with the addition of Feedback 1 and Note-taking 2. Six items loaded meaningfully onto factor two.

***(ii) Rotate the factor solution.*** The purpose of rotation is to determine the best fit between the variables and factors. Prior to rotation, Pearson's correlation revealed a modest though statistically significant correlation between the factors (*r*

= .22, *p* <.01) across both QS', hence the use of an oblique method of rotation (i.e., promax). Rotated component matrixes for QSA and QSB can be seen in Appendix 10, items with loading coefficients <.35 have been omitted.

***(iii) Interpret factor solution.*** For QSA, the rotated analysis revealed an eigenvalue of 3.13 for factor one and accounted for 17.44% of variance. An eigenvalue of 2.09 was revealed for factor two and accounted for a further 10.97% of variance (28.41% cumulative variance). For QSB, rotated analysis revealed an eigenvalue of 2.66 for factor one accounting for 13.99% of variance. An eigenvalue of 1.93 was revealed for factor two and accounted for a further 10.14% of variance (24.11% cumulative variance).

Little difference is observable between the unrotated and rotated structures. Rotated analysis resulted in all six neuromyth items loading on factor one across QSA and QSB. For QSA, Group Work 1 and Ability Grouping 1 also loaded substantively on factor one, whereas Note-taking 2 loaded substantively on factor one in QSB. Factor two has substantial loadings from six items in QSA and QSB. Practice 1, Feedback 1, and Metacognition 1 loaded meaningfully onto factor two across both QS. For QSA, factor two also consisted of Practice 2, Feedback 2, Group Work 2. Factor two in QSB consisted of both Assessment items and Ability Grouping 2. Factor one revealed strong internal consistency in both QSA ($a$ = .78) and QSB ($a$ = .65). Factor two revealed weaker alpha statistics across both QSA ($a$ = .33) and QSB ($a$ = .43).

To identify the variance explained by the factor, Dancey and Reidy (2007) suggest squaring the factor loading coefficient (see $R^2$ values in Appendix 10). Field (2005) recommends a threshold of >.40 for $R^2$ values as they account for 16% of factor variance. On that basis, it appears that both Learning Styles items play important roles in factor one across QSA and QSB. Factor two in QSA is predominantly driven by Practice 2 and Feedback 1. Zero prominent items were revealed for factor two in QSB. To summarise, factor one was predominantly driven by neuromyths in both QSA and QSB and the remaining well-established, research-based teaching principles loaded onto factor two. Consequently, analysis of *d'* and *C* were computed for overall Teacher Survey: Section Two performance but also separately for each factor

## 7.2 Main Data Analysis

### 7.2.1 RQ2: To what extent are the teaching cultures of secondary schools research informed?

**research informed?** To remind the reader, the School Survey can be found in Appendix 1 and descriptive statistics for all School Survey items can be found in Appendix 7A

***Item 3: Our school leaders take evidence from research findings into account when ... (tick all that apply).*** Most respondents reported using research-based evidence to inform the implementation of new initiatives (92.1%) and the creation of policy (76.3%). Only two respondents (5.3%) reported not taking research-based evidence into account in any of the listed circumstances. On average, respondents reported using research-based evidence as a basis for at least two of the suggested actions (*M* = 2.08). With few exceptions, high importance was placed on school leaders' taking account of research-based evidence in the suggested circumstances (*M* = 4.63; *SD* = .63; 95% CI = 4.42 - 4.84).

***Item 4: To support teachers in conducting research, our school provides... (tick all that apply).*** Allocated research time was most commonly provided (47.4%), followed by access to academic resources and support from a research lead (both 36.8%). Perhaps most surprisingly, nine respondents (23.7%) reported providing zero of the listed options. Though substantial variance was observed (*SD* = 1.32; 95% CI = 1.41 – 2.28; range = 0 – 5), on average, a relatively sparse use of support mechanisms appears to be provided by schools (*M* = 1.84). Despite sparse support, high importance was placed on supporting teachers in conducting research (*M* = 4.42; *SD* = .69; 95% CI = 4.19 - 4.65).

***Item 5: To support teachers in using research, our school provides... (tick all that apply).*** The most common support was allocated research time (44.7%) followed by access to academic resources (39.5%) and support from a research lead

(36.8%). The least common strategy was creating research reading groups (18.4%) and providing a research mentor (23.7%). On average, the total number of strategies implemented by schools was low ($M$ = 2.01) relative to the number of listed options, but variation between schools was quite substantial ($SD$ = 1.32; 95% CI = 1.58 – 2.45; range = 0 – 5). Again, almost all respondents considered supporting teachers' research utilisation to be highly important ($M$ = 4.51; $SD$ = .64; 95% CI = 4.30 - 4.72).

***Item 6: To what extent does your school encourage groups of staff (e.g., departments) to use research when making decisions?*** Respondents most commonly reported 'often' (34.2%) encouraging groups of staff to use research in their decision-making though some admitted to doing it 'rarely' (7.9%). As with each of the other items discussed thus far, respondents almost unanimously placed high importance on this construct ($M$ = 4.51; $SD$ = .79; 95% CI = 4.25 – 4.77). One respondent reported that it was 'Not Important' (2.63%).

***Item 7: Does the school in which you work employ a research lead (or equivalent)?*** Most schools reported having a research lead (52.6%). Perceptions about the importance of having a research-lead were slightly less positive than for other items but substantial variation remained ($M$ = 3.84; $SD$ = 1.10; 95% CI = 3.48 – 4.20; range = 1-5).

***Item 8: The person responsible for teachers' professional development regularly communicates with all teaching staff to provide... (tick all that apply).*** The interpretation is that respondents will have chosen the response reflecting the most common reason for communicating with teachers. CPD opportunities was most commonly selected (44.7%) distantly followed by opportunities to collaborate with colleagues in research (23.7%). Opportunities to become involved in research with HE institutions and the communication of research-based academic resources were least commonly selected (each 5.3%). Little variation was observed in the high importance respondents reported (*M* = 4.50; *SD* = .64; 95% CI = 4.25 – 4.75; range = 3 – 5).

***Item 9: How regularly does the person responsible for teachers' professional development communicate with HE institutions and/or external bodies (e.g., Education Endowment Foundation)?*** Most commonly, respondents reported regular communication (scale-point four) (28.9%), however, broad variation was observed (*M* = 2.96; *SD* = 1.25; 95% CI = 2.55 – 3.37; range 1-5). On average, respondents placed less importance on this construct compared to most other items (*M* = 3.87; *SD* = .71; 95% CI = 3.63 – 4.10; range = 2 – 5).

***Item 10: Research is used within our school to create a culture of... (tick all that apply).*** Most schools reported using research to develop reflection (71.8%) and creativity (57.8%) with fewer using research to develop criticality (31.5%). Most reported using research for at-least one purpose (*M* = 1.67; *SD* = .90; 95% CI = 1.37 - 197). Three schools reported using it to develop zero of the stated options (7.89%). Generally, high importance was placed on using research to develop a school's culture (*M* = 4.05; *SD* = .84; 95% CI = 3.87 – 4.33; range = 2 – 5).

***Item 11: To what extent are teachers encouraged to consider research that challenges their conceptions about T&L?*** Despite only 31.5% of respondents reportedly using research to develop criticality in the previous item, participants most commonly reported 'often' encouraging teachers to consider research findings that challenge their T&L conceptions (36.8%). Scale-point four was the next most selected (28.9%). Zero respondents reported 'rarely encouraging' teachers to use research for this purpose. Generally, strong importance was placed on the importance of teachers using research in this way, though there were two exceptions (*M* = 4.24; *SD* = .70; 95% CI = 4.01 – 4.47; range = 2 – 5).

***Item 12: How many teachers are involved in the following activities... (tick all that apply).*** To ease interpretation, commentary here is best read alongside the corresponding matrix table in this item in Appendix 7A. For ‘All teachers’, respondents most commonly selected regular staff briefings (81.6%), closely followed by dedicated CPD days (78.9%). One respondent reported that ‘All teachers’ are involved in no research activity (2.6%). School-based research conferences (63.2%) and publications (55.3%) were most selected for ‘Some teachers’. Perhaps most strikingly, ‘no research activity’ was commonly selected for ‘most teachers’ (18.4%). Nonetheless, high importance was almost consistently reported on teachers engaging in research activity ($M$ = 4.37; $SD$ = .73; 95% CI = 4.12 – 4.61; range = 2 -5).

***Item 13: To what extent are collaborations with external partners used purposely to challenge teachers' conceptions about T&L?*** The scale mid-point was most selected (34.2%) and slightly below the mean ($M$ = 3.29). Relatively high variation was observed between respondents ($SD$ = 1.11; 95% CI = 2.92 – 3.66; range = 1 – 5). One respondent (2.6%) reported ‘none’ and seven (18.4%) reported ‘a lot’ of collaboration with external partners. The variation mentioned above is mirrored in the importance respondents reported ($M$ = 4.00; $SD$ = .83; 95% CI = 3.73 – 4.27; range = 2 – 5).

***Item 14: Our school has the following quality assurance procedures in place to ensure that research we conduct is high-quality... (tick all that apply).*** Respondents most often reported that their school had zero quality assurance procedures in place for this purpose (44.7%). Of those with such procedures, communication with a teaching school (34.2%) and provision of academic resources (28.9%) were most common. On average, respondents reported implementing little over one quality assurance procedure, though responses varied substantially ($M$ = 1.20; $SD$ = 1.24; 95% CI = 0.81 – 2.35; range = 0 – 5). Generally, high importance was placed on quality assurance procedures ($M$ = 4.38; $SD$ = .82; 95% CI = 3.76 – 4.85; range = 2 – 5).

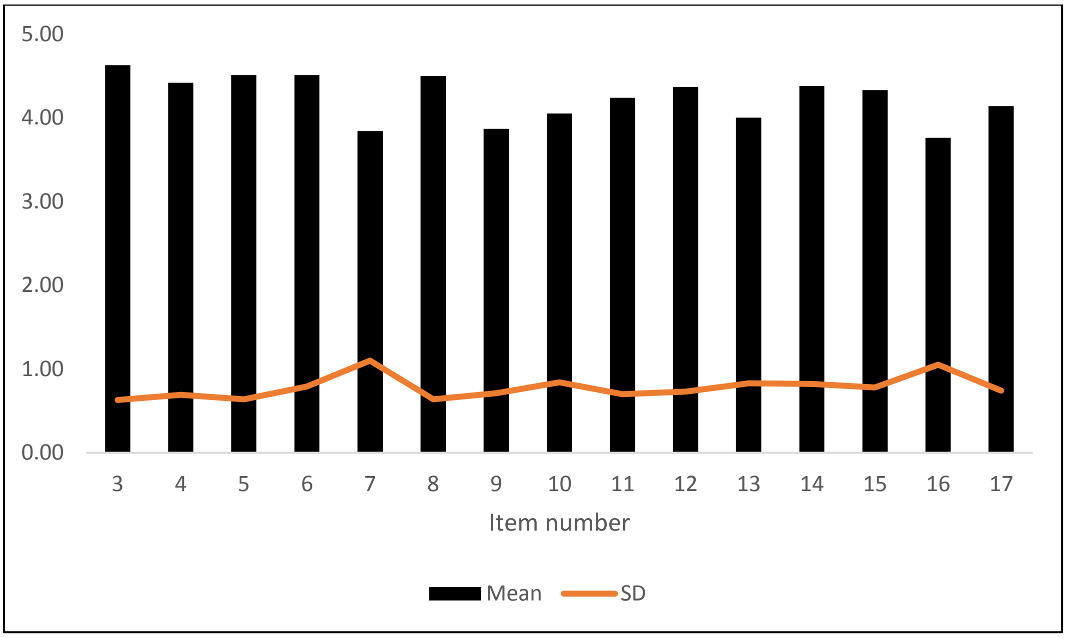
***Item 15: To what extent is research used as a tool to promote professional dialogue amongst teachers?*** Scale-point four was most regularly selected (53.3%) therefore suggesting that research is commonly used as a tool to promote professional dialogue, though the mean was slightly below (*M* = 3.50). Zero respondents reported that research is not used for promoting professional dialogue. Respondents consistently reported placing high importance on the use of research for this purpose (*M* = 4.33; *SD* = .78; 95% CI = 4.07 – 4.59; range = 2 – 5).

***Item 16: Our school supports all teachers in undertaking post-graduate study through... (tick all that apply).*** Additional CPD opportunities (55.3%) and financial support (42.1%) were the two mechanisms most reported. Nine respondents reported zero support mechanisms (23.7%). On average, respondents reported considering support for teachers' post-graduate study to be less important than most other items (*M* = 1.41; *SD* = 1.12; 95% CI = 1.04 – 1.78; range = 0 – 4).

***Item 17: Our school has the following quality assurance procedures in place to ensure that research we use is high-quality... (tick all that apply).*** Having zero quality assurance procedures in place to ensure research used is high-quality was most selected (47.4%). Of those with quality assurance procedures in place, research-focused workshops and communication with teaching schools were selected most often (28.9%), followed by access to academic journals (26.3%). Despite zero quality assurance procedures being most selected (47.4%), respondents generally placed high importance on having them (*M* = 4.14; *SD* = .74; 95% CI = 3.90 – 4.39; range = 2 – 5).

Figure 7.3 depicts the mean (and *SD*) reported importance for each School Survey item. As evidenced by the consistently high mean score and relatively stable standard deviation, respondents appeared to place high importance on almost all constructs within Cain's (2018) framework.

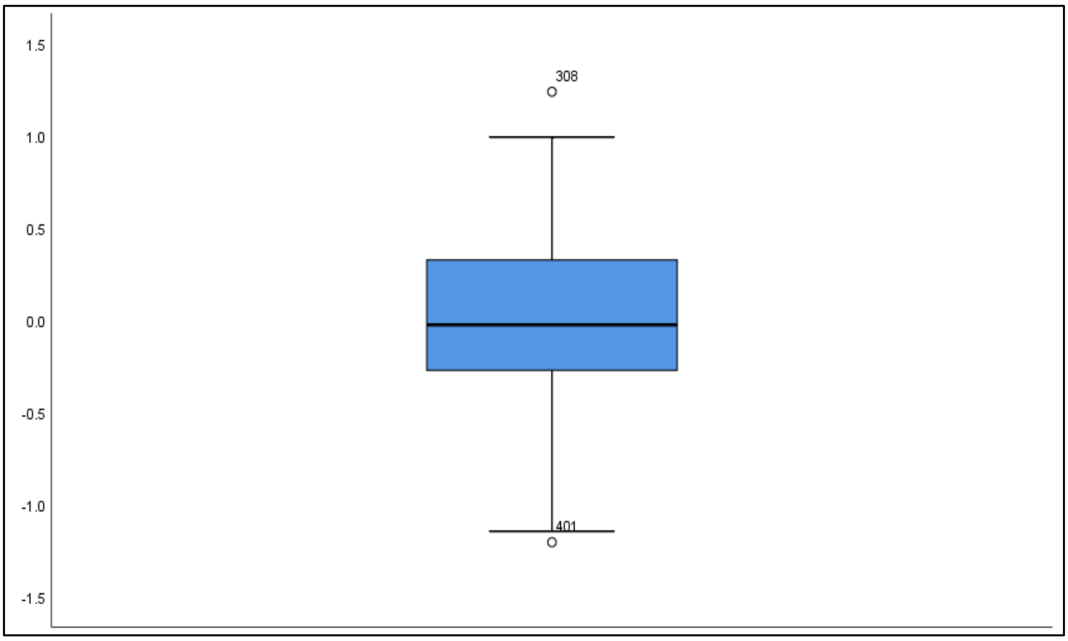
Figure 7.3. Mean importance and standard deviation per supplementary importance item




After planning this investigation, two additional coding 'rules' were imposed due to received responses which could not have been foreseen. Firstly, some 'Other' responses referred to strategies yet to be operationalised, for which respondents were given a half-score (0.5). For example, in response to item 3, School 18 reported that their school leaders do not yet take research findings into account when creating policy but it 'is something that they are making progress towards'. Secondly, as mentioned earlier, three schools provided two responses to the School Survey. These instances were dealt with by computing mean scores between respondents (sometimes resulting in half-scores).

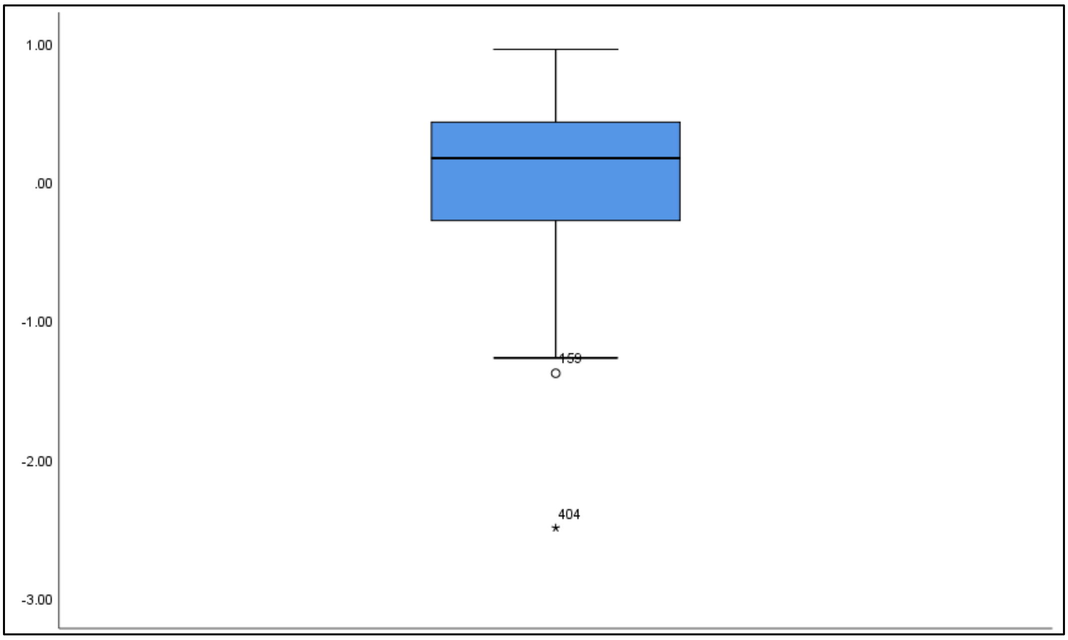
The extent to which each school has developed a research-informed culture was measured by normalising (i.e., standardising) items, summing responses to all items, and then dividing by 15 (i.e., number of School Survey items). The outcome of this is presented as the 'standardised total research-informed culture' variable. Without standardisation some survey items would have been worth six-times (e.g., item 5) more than others (e.g., item 7) due to the number of points available. This was problematic because there is no evidence that some constructs of Cain's (2018) framework are more important (and should therefore carry more points) than others. Descriptive statistics for the standardised total research-informed culture scores (*SD* = .59; 95% CI = -.20 – .20; range = -1.21 – 1.24) suggest that the population mean is within the range -.20 - .20 and 66% of the school sample sit within -.30 - .30. Figure 7.4 identifies two schools at either end of the scale as being anomalies (School 29 at upper end, School 36 at lower end). Despite the outliers, that variable was normally distributed and passed Shapiro-Wilk's test ($p > .05$).

Figure 7.4. Boxplot for standardised total research-informed culture score




To calculate how important respondents perceived the construct within Cain's (2018) framework to be collectively for developing a research-informed culture, standardised total importance scores were calculated in the same way as discussed above. Descriptive standardised total importance results (*SD* = .72; 95% CI = -.24 – .24; range = -2.50 – .95) suggest greater variation than observed in standardised total research-informed culture scores, but a broadly more positive outlook with the confidence intervals being slightly increased. As for the previous variable, School 36 was again a low scoring outlier (observable in Figure 7.5). With School 36 included, the data failed the Shapiro-Wilk test ($p <.01$), however, upon removal the data was normally distributed ($p > .05$). Consequently, that school was removed from further analysis utilising this variable.

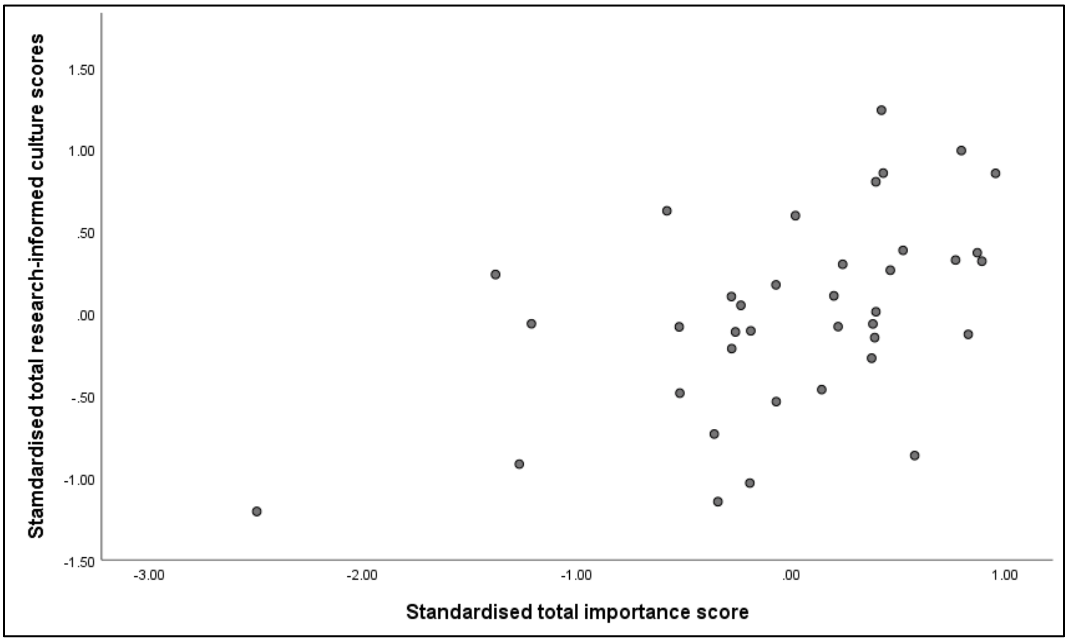
Figure 7.5. Standardised total importance scores




A Spearman's Rho correlation revealed a significant moderate positive correlation between each school's standardised total-research-informed culture and standardised total importance score ($r$ (35) = .62, $p$ <.01) (Figure 7.6). Essentially, schools who took more steps to become research-informed reported placing greater importance on doing so.

To summarise, most schools centred very close to average in terms of the steps they took to develop a research-informed culture (i.e., standardised total research-informed culture score) and the importance they placed on doing so (i.e., standardised total importance scores). However, total research-informed culture scores were usually substantially lower than the standardised total-importance scores. This suggests that schools usually place high importance on taking steps to develop a research-informed culture but are less forward in actually implementing steps.

Figure 7.6. Standardised total research-informed culture scores versus Standardised total importance scores.




**7.2.2 RQ3: What perceptions do teachers hold about the usefulness of using educational research to guide practice?** To reiterate, the full Teacher Survey can be found in Appendix 2 and descriptive statistics for all Teacher Survey: Section One items can be found in Appendix 7B

***Item 9: How appropriately can educational research findings be used to guide general educational practice?*** Most teachers (55.7%) selected scale-point four, thereby suggesting that they feel educational research findings are appropriate for guiding educational practice ($M$ = 3.89; $SD$ = .76; 95% CI = 3.81 – 3.96).

***Item 9A: For what reason(s) do you consider educational research findings to be inappropriate for guiding educational practice?***

*Methodological concerns.* 201 responses were categorised under 'methodological concerns'. Broadly, these responses reflected participant perceptions that methodological shortcomings (e.g., inability to ascertain validity) of educational research render it incapable of meeting teachers' needs. Within this category, there were more specific aspects of research methodology which respondents commonly illustrated as being obstructive for utilising educational research to guide teaching practice. Each of those aspects will be described and supported by corresponding sample responses.

*Methodological concerns: Generalisability.* Most participants (*n* = 110) citing methodological concerns focused on a perceived failure of researchers to ensure findings are generalizable across students, subjects, settings, academic levels, and social contexts. Some identified problems with research 'focusing on one subject area' because it was therefore 'unsuitable' for utilisation by teachers of different subjects. Similar concerns were raised about generalising research findings across 'grammar schools compared to inner-city state comprehensive schools' due to an expectation of 'very different success rates'. In contrast, one participant argued that 'research findings are too generalised to relate perfectly to the individual nature of teaching pupils'. There was a common thread within responses grouped here that 'one size doesn't fit all' and educational research is often conducted in settings which render it largely redundant for 'our' students.

*Methodological concerns: Research methods in general.* 45 participants highlighted more general concern that educational research is often 'low quality and poorly controlled', 'poorly executed', and/or 'based on very little evidence'. Perhaps acknowledging the complexity of teaching, some attributed perceived inadequate research methodology to 'too many uncontrollable variables', and a 'large number of variables at play in classroom setting (are) difficult to account for in research'. Others attributed perceived inadequate research methods used in educational research to a lack of rigour or 'attention' from researchers. For example, one respondent reported that 'sometimes not enough detail is given of the length of the study, the numbers involved and the educational setting from which the research stems'.

*Methodological concerns: Nature of researchers.* 'Was the researcher a teacher? If not, I wouldn't trust it'. 11 participants noted distrust in 'non-teaching researchers' who can be 'ignorant of what the day to day educating of teens is really like'. To obtain credibility, respondents required that researchers have 'personal experience of working with children'. Said perspectives were summed up in the following response: 'I perceive educational research to be carried out by university-based academics who have very little/no classroom experience.... I feel as though it's a case of people in offices making decisions and thinking they know best when they have no idea about the reality of teaching'.

*Methodological concerns: Sampling.* Building on concern that educational research often lacks generalisability, 35 participants expressed specific concern about: a) the size of research sample (e.g., 'too small or narrow'), and/or b) or the nature of the sample (e.g. participating schools or pupils unrepresentative of 'our' school or pupils).

*Zero reasons.* 23.76% (*n* = 101) of participants were either unable or unwilling to state any reason why educational might be inappropriate for guiding practice. Common examples of responses in this category include: 'N/A', 'I believe that findings are appropriate', and 'I don´t think there are any reason for what educational research findings could be inappropriate for guiding educational practice'.

*Practical obstacles: Time.* 28 of the respondents citing practical obstacles (*n* = 48) complained that 'many teachers do not have the time to read research' sometimes due to 'commitments in the classroom and at home', 'pragmatic needs of the curriculum and the needs of the pupils', and 'rigours/requirements of external exams'. Though plenty acknowledged that research engagement is time-consuming, very few explicitly stated why. One participant attributed time consumption to evaluating 'the authenticity of the report, the sources, sample sizes, peer reviewing'. Broadly, there was a feeling that research engagement should not be prioritised because, for example, that time 'could be spent marking or planning which improves teaching more'.

*Practical obstacles: Implementation.* Several (*n* = 11) participants reported that educational research often encompassed ‘too much information’ and is ‘hard to transfer from theory to practice’. However, some also reported that ‘researchers often don’t provide sufficient instruction as to how interventions can be implemente*d’* which added to ‘difficulty applying [research findings] to a teaching context’. Others focused on physical obstacles to implementing research findings (e.g., ‘constraints of equipment and/or facilities’), and bureaucratic obstacles (e.g., ‘educational practice in schools is a very restricted system and research cannot always be applied’).

*Practical obstacles: Accessing research.* Nine participants raised problems of physical and/or intellectual access. Physical access obstacles were generally attributed to a lack of school funding. A classic example for the latter being difficulty implementing research findings because they are ‘too complicated when teachers are searching for a 'quick answer’.

*Disparity between theory and practice.* 32 responses (7.52%) centred on educational research being too far removed from teaching practice (e.g., ‘theory and practice are too very different things’; ‘theories never work in real practice’). Given that theory was not mentioned in the item, the examples provided may illustrate a perception that some see educational research and theory as synonymous. Others provided more general responses, arguing that educational research is ‘often not closely enough linked to reality’ and consequently ‘does not hold true in reality’.

*Alternative agenda of educational research.* The 12 responses placed within this category illustrated disgruntlement at the ‘hidden agenda’ or strategic use of research findings by researchers (e.g., ‘research...keeps researchers in a job’), SMTs (e.g., ‘SLT can use research tactfully to manipulate desired practices’), and/or policy-makers (e.g., ‘[Research is] Often ignored or misused by governments to fulfil an ideological agenda'). Responses here broadly presented a trend that educational research is conducted and selected by people who 'have a vested interest' and, for respondents, this has resulted in the 'spawning of fads'.

*Other.* Responses were usually placed in this category if they included insufficient detail and/or context to enable intelligible interpretation (e.g., 'new ideas/strategies', 'to inform best practices'). A minority of responses within this category were anomalies and thereby did not warrant creating a separate category (e.g., 'if it is not used to build upon a solid foundation of teaching in the classroom').

***Item 9B: What are the benefits of using educational research findings to guide educational practice?***

*Facilitate evidence-based practice.* 215 (50.59%) teachers provided positive responses about the prospect of using educational research to develop evidence-based practice.

*Facilitate evidence-based practice: 'Concrete' evidence.* Despite commonly reporting perceived methodological issues in item 9A, 72 respondents reported that research can provide teachers with 'soli*d'*, 'concrete' evidence 'with a proven impact of being successful'. Responses grouped here often suggested that guidance provided by educational research findings is superior to 'anecdotal guidance' or that provided from other sources. For example, respondents argued that research 'provides 'real' data' and 'allows teachers access to an impartial evidence-base' which is 'developed by teaching experts'. As illustrated in the following quote, teachers viewed research as a tool to 'debunk myths' almost as commonly as they saw it as a tool to identify 'what works': 'clear guidance on pedagogical approaches that have impact, and avoidance of faddy gimmicks'.

*Facilitate evidence-based practice: Improve teaching quality and student outcomes.* For some, engagement with research appeared almost synonymous with improved student outcomes which included but were not limited to ‘developing pupil progress and raising achievement’. For example, three respondents argued that research engagement can: ‘make pupils more resilient’, ‘improve engagement’, and ‘develop teacher-student relationships’. Respondents here predominantly took the stance that achievement across ‘all levels’ would be enhanced through an evidence-based approach to practice. Some were more specific, reporting that research engagement will either: a) ‘benefit the students who are average’ or ‘help the less able pupils’.

Some respondents seen improved outcomes as a result of research enabling ‘teaching in-line with understanding of how brain works/how learning happens so we should expect a raise in T&L’. Rather than alluding to evidence-based teaching as in the previous quote, some adopted a more research-informed perspective, arguing that research can ‘inform teaching strategies in order to develop pupil progress and raise achievement’ and ‘help us to better guide pupils in how to learn and us (teachers) on how to teach’.

*Enhance reflective processes.* Many participants (*n* = 150) reported that research can contribute to teachers’ reflective processes. However, within those responses there was great variation about exactly what role research might have hence the sub-categories to be discussed.

*Enhance reflective processes: Collaboration.* Underpinning many responses (*n* = 86) about the role of research in developing their reflection was the opportunity to learn vicariously (i.e., ‘from others' practice’) by ‘providing a range of experiences’ and an ‘insight into what other schools/ teachers are doing’. Educational research was a vehicle for the ‘sharing of good pedagogical practice, transfer of knowledge’ of ‘new approaches that have been tested elsewhere’. In contrast to some of the perspectives provided for item 9A, several participants perceived researchers to be bias-free thereby providing an ‘opportunity to objectively consider issues and areas for development’.

*Enhance reflective processes: Planning.* Several participants (*n* = 64) reported that research can provide 'support for planning' by 'predicting behaviours' and helping 'teachers to anticipate the future of learning needs, and devise strategies'. Here, participants essentially seen research as providing 'answers' to several challenges including:

> 'classroom management techniques, behaviour management techniques and teaching certain topics in tricky situations. How to deal with incidents and anything else that occurs'.

Research also reportedly provides 'fresh ideas to new teachers or teachers who may have become a little stagnant', 'add strings to bows and ideas to backpacks' and 'helps us evaluate our own practice and consider other ways of approaching T&L.'.

*Professionally desirable.* 33 (7.76%) participants reported that research engagement was 'good for CPD', however, there was broad variation in justifications as to why. Some, as in the case of the previous quote, provided none. Others seemed unenthusiastic about the way research is used to enhance CPD (e.g., 'I don't think there are any - besides to tick a box?'). Despite previously criticising the use of research for strategic purposes by SMT and/or policy-makers, others reported using research in similar ways because 'it gives substance to requests to governors/senior team to try new practice', or as another put it, research 'carries kudos with leaders and hence easier to implement'. A final sub-section of responses seen research as a tool to 'tell us about changes in society, enlightening us on a broader scale', thereby suggesting that their perception of CPD also encompasses broader societal issues.

*Zero benefits.* 11 (2.58%) participants were unable or unwilling to report any benefits of using educational research to guide practice. Typical responses in this category included: 'I'*M* not sure about what benefits there really are for me' and 'N/A'. Responses like the former were often provided by those who rated the usefulness of educational research for guiding educational practice to be low.

*Other.* Of the 13 (3.06%) responses in this category, most were void of the detail required for interpretation (e.g., 'educational background and experienced practitioners', 'hopefully it is real'. Others were sensical but did not warrant the creation of a separate category (e.g., 'Keeping up with technology').

***Item 10 – To what extent is your teaching practice influenced by educational research findings?*** Though the mean was slightly higher ($M$ = 3.34), the scale mid-point was most selected (40.2%) suggesting that they perceive their practice to be moderately influenced by educational research findings. Four teachers reported that their practice is 'not influence*d'* by educational research (0.9%).

***Item 10A - In what ways do educational research findings influence your practice?*** Responses to this item were highly varied and usually equally vague. Broadly, distinctions were made about whether teachers used educational research findings to influence their practice in *general* or *specific* ways.

*Specific.* 230 responses (54.1%) reported using either: a) specific resources (which participants considered to be educational research), and/ or b) educational research to improve a specific element of their practice. A few respondents also reported using action-research to target problems or 'reduce using strategies that, on average, have less success in the classroom'. Those who referred to specific educational research cited various resources which may reflect differing perspectives about what constitutes educational research. For example, some referred to educational research sourced from the Chartered College of teachers' and 'links provided by universities', others spoke about utilising 'Mr Barton's silent examples'. While the Mr Barton resource may provide teaching strategies (amongst other things), it is unclear whether it constitutes educational research. Essentially, some responses seemed to conflate educational research with brands. Dylan Wiliam's work on assessment-for-learning was the only which was cited on multiple occasions. Usually, educational research was used to target specific aspects of classroom practice (e.g., 'behaviour management', 'cognitive load', 'questioning') although sometimes respondents reported using it to enhance elements outside of the classroom (e.g., 'promotion of healthy lifestyles', 'planning', 'increase extra-curricular participation').

*General.* The remaining participants spoke in more general (and often vague) terms about how educational research influences their practice. The following is a typical response in this category: 'use research to inform classroom practice'. Some offered a little more insight, for example, reporting using only research 'which has been shown to have a positive impact on students'. Perhaps the most notable distinction within this group was based on the extent to which participants perceived that research influenced their practice. For example, some respondents reported using research to 'try out' strategies whereas others simply implemented those which they considered to be 'ready-made'.

***Item 10B - What obstacles do you face in using educational research findings to influence your practice?*** *Time.* The most reported (*n* = 187 (44.0%)) obstacle teachers face was a lack of time. Many lamented having 'no allocated research time and no spare time to engage with it'. Reiterating limitations commonly cited in item 9A, respondents regularly illustrated disgruntlement at the presentation of research in 'wordy documents' when 'time necessitates a quick read'. Many felt that 'accessing and reading' research were the time consuming elements of research engagement, only a handful highlighted the 'adaptation and implementation' of findings' as being time intensive.

'Curriculum needs', 'exam pressures', 'workload', and time spent planning were commonly discussed pressing means of time utilisation superseding research engagement. The latter draws interest because in item 9B many respondents seen educational research as a contributor to their planning. Additionally, despite item 10 asking specifically about 'using educational research findings', several participants responded by discussing conducting research. For example, one respondent stated that they ‘do not always have the time to carry out research’ – perhaps reflecting different conceptions teachers have of what it means to engage with research.

*Research validity.* Reinforcing perceived limitations commonly reported in item 9A, 90 (21.2%) respondents reported concern that ‘research from different settings is not always appropriate to my school or classroom’. Some also argued that ‘research findings do not work the same with different age groups, different abilities or subjects’. Less commonly, respondents argued that their ‘teaching style does not always work with some of the research suggestions’. Essentially, teachers were more often concerned about the relevance of research to their school setting rather than how closely it aligns with their approach to practice.

The second main source of distrust about the validity of research was a consequence of perceived ‘constant contradiction, advice, and guidance’ from researchers. Many agreed, arguing that educational research provides ‘yet another different metho*d’* before requesting ‘some continuity’. In stark contrast, a similar number of respondents reported that educational research results are ‘constantly reinventing the wheel’. Other, less common, justifications for questioning the validity of research included: a perceived ‘distance between how things work in theory and in practice’, and a belief that ‘they’re too general... I find that my experience works better’

*Access.* 69 (16.2%) participants reported access issues as obstacles in using educational research. As previously, responses here were split between physical (e.g., lack of resources) and intellectual (e.g., difficulty understanding educational research) access issues.

*Access: Physical.* Issues of physical access were more commonly reported than intellectual obstacles. Physical access obstacles centred on difficulty obtaining access to research literature often hidden behind paywalls and/or registration-required journals. Interestingly, zero respondents acknowledged the abundance of practitioner texts available (one participant mentioned the EEF database). A handful reported participating in university-based post-graduate programmes which offered greater access.

*Access: Intellectual.* Here, participants complained that research is both: a) 'complicated' and, b) 'not in easily-digestible format'. Consequently, participants reported feeling they 'don't know enough... about educational research' and are poorly placed to 'judge its validity'. For one participant intellectual obstacles occurred at a more fundamental level reporting that she was unsure 'where to find the latest research'. Several participants reported that issues of access resulted in feelings of 'frustration'.

*Implementation.* 42 (9.9%) participants highlighted difficulty 'trying new ideas and methods' sourced from educational research for various reasons. Some reported difficulty in obtaining sufficient 'time to prepare resources/integrate research findings into lessons' perhaps due to the 'other pressures of teaching'. Others lamented obstructive colleagues unwilling to implement research-based findings due to a 'perception that it is labour adding not labour saving'. SMTs were also criticised for obstructing implementation of research-based findings; for example, '(In)Consistency of senior management - scattergun approach/no follow-up - just responding to interpretation of Ofsted criteria for outstanding'.

*Zero obstacles.* 16 (3.7%) respondents explicitly stated that they face zero obstacles in engaging with educational research

*Other.* As with previous responses categorised as 'Other', 21 teachers (4.8%) provided responses which: a) were unintelligible (e.g., 'v') , b) provided insufficient detail for interpretation (e.g., 'lack of examples'), and/or c) an inappropriate response to the question. An example of the latter is provided here: 'Using twilight sessions at the school as part of the allotted CPD time has been invaluable for this and has helped me tackle areas on the faculty development plan'.

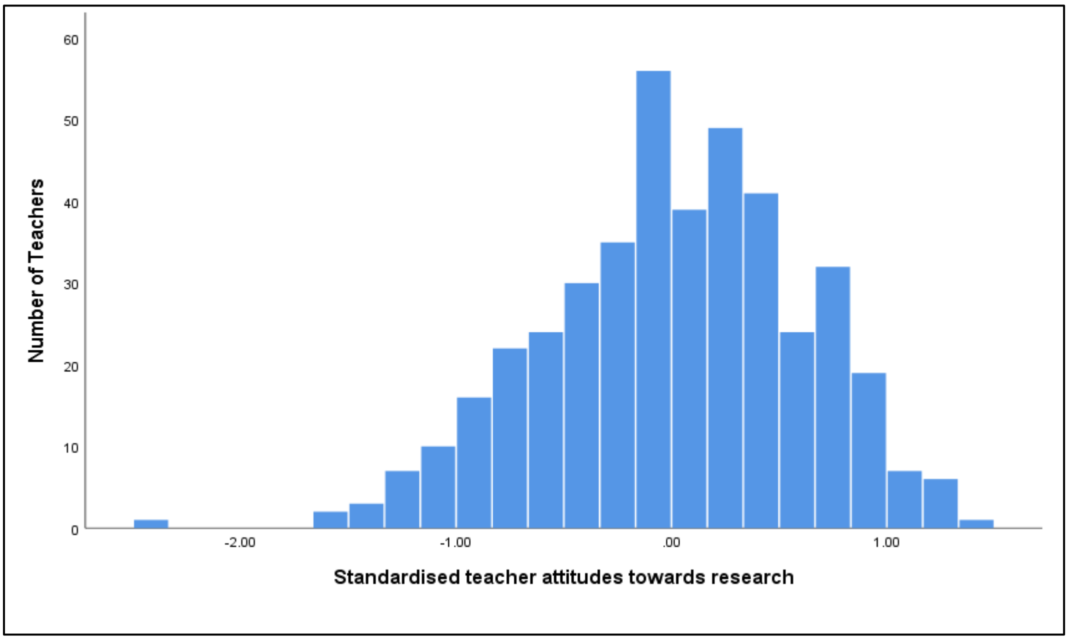
***Item 11 - What resources do teachers typically use to remain research-informed? (Tick all that apply).*** Most teachers reported using between 2 and 4 resources to remain research engaged, however, substantial variation was observed (*M* = 3.12; *SD* = 1.33; 95% CI = 2.99 – 3.24; range = 0 – 6). Of the types of resources used, dialogue with peers (84.6%) and social networking (64.5%) were most selected. More formal methods of research engagement including accessing academic journal (27.1%) and books (41%) were least commonly utilised. 10 teachers reported using zero resources (2.3%).

***Item 12 - What steps do teachers take to maintain educational research currency? (Tick all that apply).*** The average number of steps teachers take to maintain knowledge of educational research was low (*M* = 1.47; *SD* = 0.79; 95% CI = 1.40 – 1.55; range = 0 – 4). Zero teachers reported partaking in all five listed steps and 19 reported taking zero steps (4.3%). School-based CPD (86.4%) and school-based research collaborations (29.6%) were most commonly selected.

Items 9 and 10 from the Teacher Survey: Section One identified teachers' attitudes about the usefulness of educational research findings in guiding practice. items 11 and 12 addressed the resources and steps teachers use to maintain currency with educational research. In combination, those items formed the 'standardised teacher attitudes towards the usefulness of educational research findings' variable. A Pearson's correlation revealed a significant moderate positive correlation between participant responses to items 9 & 10 and items 11 & 12 ($r$ (423) = .38, $p$ <.001). Those with perceptions that educational research is more useful also reported taking more steps to maintain currency with it. Alike the process described previously, the items within Teacher Survey: Section One were standardised (*SD* = .61; 95% CI = -.06 - .06; range = -2.34 – 1.44).

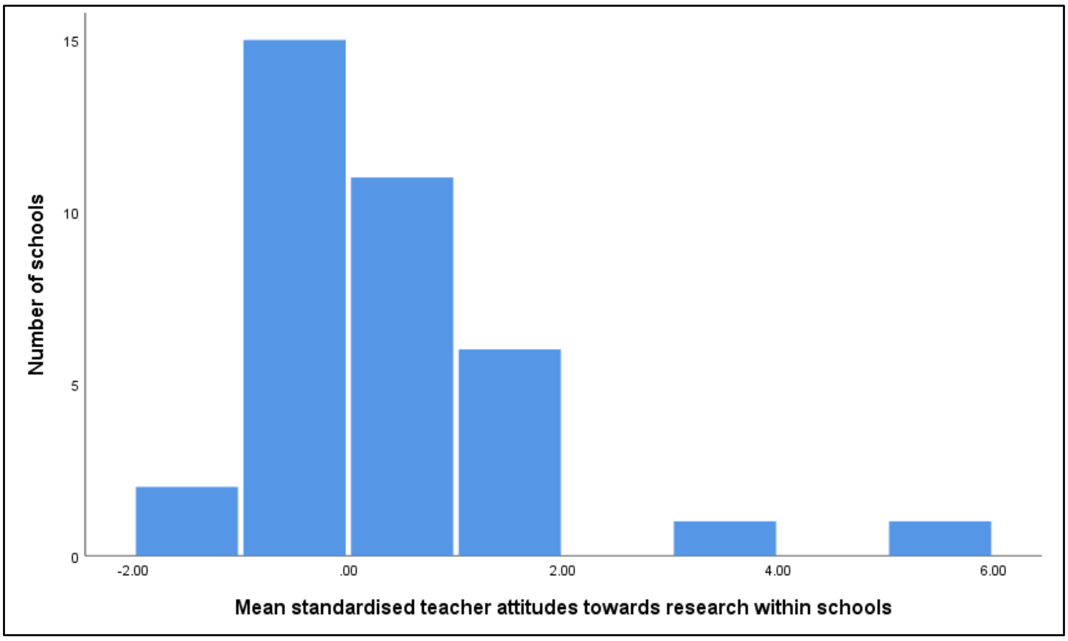
Standardised teacher attitudes towards the usefulness of educational research findings failed the homogeneity test ($p$ < .05). Skewness (-.03) and kurtosis (-.03) are depicted in Figure 7.7 where the data sits predominantly to the right of the diagram. Figure 7.7 also illustrates one clear low scoring outlier (-2.34), however, removing that individual from analysis had little impact on data distribution therefore it remained. The highest scoring respondent was the sole participant from School 12 (1.44), however, as that person was responsible for teachers' professional development within that school and we might therefore expect more enthusiasm about the role of educational research.

Figure 7.7. Standardised teacher attitudes towards research




As analysis for RQ5 takes place at the school-level, teachers' attitudes towards the usefulness of educational research for guiding practice were grouped within their respective schools. Figure 7.8 illustrates the mean within schools thereby also facilitating comparison across schools (*SD* = .41; 95% CI = -.06 - .87; range = -1.76 – 5.77). School 6 provided the lowest mean score (-1.76) and School 12 provided the highest score (5.77). Data distribution failed the Shapro-Wilk test (*p* >.05) with and without the highest scoring outlier therefore no data was removed.

Figure 7.8. Mean standardised teacher attitudes towards research within each school




Due to the non-normal data distribution, a Mann-Whitney U test was conducted and revealed that School Survey respondents (who also completed the Teacher Survey) ($n$ = 21; $M$ = .67; median = .66) reported significantly more positive attitudes about the usefulness of educational research findings than Teacher Survey respondents ($n$ = 404; $M$ = -.03; median = -.01) ($U$ = 7039, $p$ <.01).

Spearman's Rho analyses revealed no relationship between teacher attitudes towards research and their *C* scores ($r$ (423) = .03, $p$ = .13) thereby suggesting that teachers' criterion for reporting items to be true was not influenced by their perception about the usefulness of research. However, a significant weak positive correlation between teacher attitudes towards research and overall *d'* ($r$ (423) = .15, $p$ < .01) thereby suggesting that those who are more positive about the prospect of using educational research to guide practice were better able to identify well-established, research-based teaching principles.

To summarise, teachers within the recruited sample generally reported that educational research findings: a) are appropriate for guiding teaching practice, and b) have a moderate influence in guiding their practice. Almost one-quarter of respondents were unable to cite any reasons why educational research findings may be inappropriate for guiding practice whereas <3%  were unable to cite a benefit.

Those who reported reasons why educational research findings are unfit for guiding practice communicated various explanations but mostly pointed to methodological concerns and practical obstacles. Similarly, teachers reported a wide variety of benefits of guiding practice with educational research; most commonly commenting that educational research can facilitate evidence-based education and contribute to their reflective processes. To maintain currency with educational research findings, teachers reported accessing an average of slightly over three resources. Informal resources (e.g., dialogue with peers) were selected more commonly than formal resources (e.g., academic journals). Teachers reported being less active in engaging in professional development activities (e.g., research-collaborations), with most of those who do engage in such activities being limited to school-based CPD events.

Respondents who cited more positive attitudes about the use of educational research findings for guiding practice also reported being more active in maintaining currency with it and were more able to accurately identify well-established, research-based teaching principles. Finally, substantial within- and between- school differences were observed in the attitudes that teachers have towards the usefulness of educational research findings and the steps that they take to engage with it.

**7.2.3 RQ4: To what extent are teachers aware of well-established educational research-based findings?** Overall *d′* (*M* = .74; *SD* = 1.44; SE = .07; 95% CI = -.60 - .87; range = 10.28) scores reveal that teachers' ability to identify well-established research-based teaching principles is little better than that expected by chance (*d′* = 0 is chance level). The lowest observed *d′* was -1.75, achieved by three participants (from separate schools) who responded correctly to four of 19 items. The highest *d′*, 8.53, was achieved by five participants (from five different schools) after accurately reporting all hits and receiving zero false alarms. Though Figure 7.9.1 depicts the highest and lowest performers as outliers, the data was valid and therefore retained. A t-test revealed no significant differences in *d′* scores between QSA (*M* = 0.80, *SD* = 1.58; SE = .09, range = -1.74 - 8.53) and QSB (*M* = 0.64, *SD* = 1.20, SE = .09, range = -1.71 - 3.23) ($t$ (423) = 1.14, $p$ = .26).

Overall mean *d′* between schools can be seen in Figure 7.10, which illustrates that School 30 achieved the highest mean *d′* (2.85) and School 21 achieved the lowest *d′* (-0.03). School 12 has been excluded from discussion here because data is based on only a single response. The mean *d′* standard deviation within-schools is 1.15. Within School 9 and School 32 the variation was substantially greater (*SD* = 5.34 & 4.12, respectively), with the lowest variation found in School 36 (*SD* = .15).

Overall *d′* distribution failed the Shapiro-Wilk homogeneity test ($p < .01$) with skewness of 2.82 and kurtosis of 10.74 (Figure 7.9.2). Variables failing the Shapiro-Wilk test were visually inspected using box-plots, histograms, and Q – Q plots to identify the extent and cause of non-normality. Q-Q plot (Figure 7.9.3) illustrates that data points deviated from frequencies expected of a normal distribution at both scale-ends. The boxplot (Figure 7.9.1) reveals several predominantly high *d′* outliers, each from a different school. The boxplot interquartile tells us that 50% of participant *d′* scores fell between -.01 - 1.01, suggesting that they are little more able to identify well-established, research-based teaching principles than expected through chance.

Using 1.01 as a base-mark, only 98 (23.06%) respondents would be considered ‘research-inform*ed′*. Figure 7.11 illustrates the percentage of respondents from each participating school who achieved *d′* >1.01. Although School 12 has a 100% rate, only one response was received therefore it seems that School 29 has the highest proportion of research-informed teachers (66.66%) and School 35 has the lowest (0%). School 12 and schools which failed to provide any Teacher Survey responses notwithstanding, there was substantial variation between schools in the percentage of teachers who are research-informed (mean = 28.90%; *SD* = 15.03%; range = 0% – 62.5%).

Figure 7.9.1. Overall *d'* boxplot

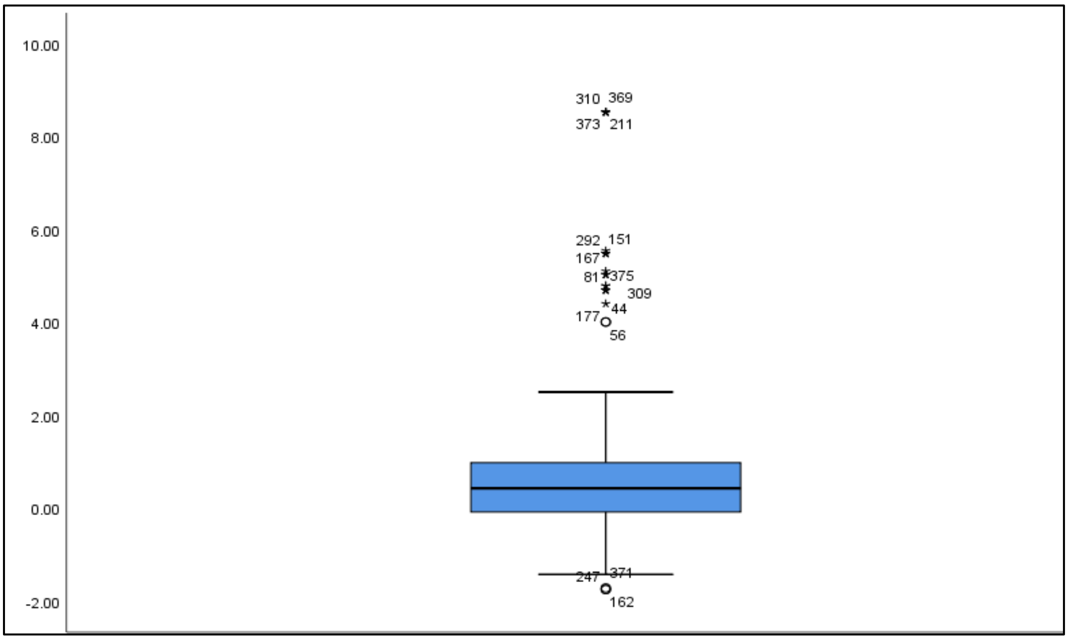



Figure 7.9.2. Overall *d'* histogram

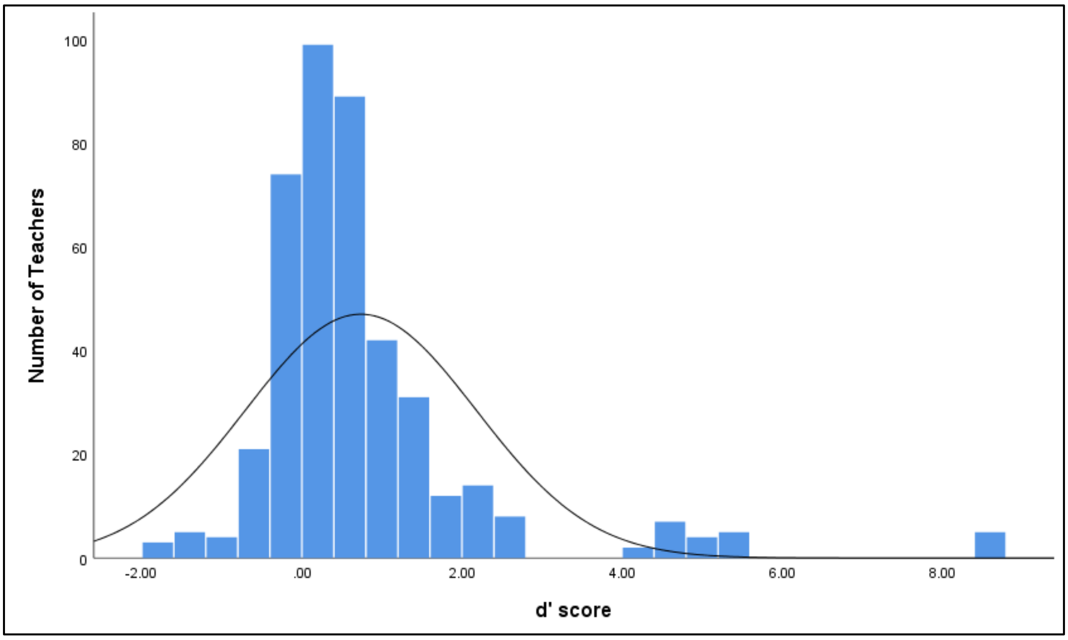


Figure 7.9.3. Overall *d′* Q – Q plot

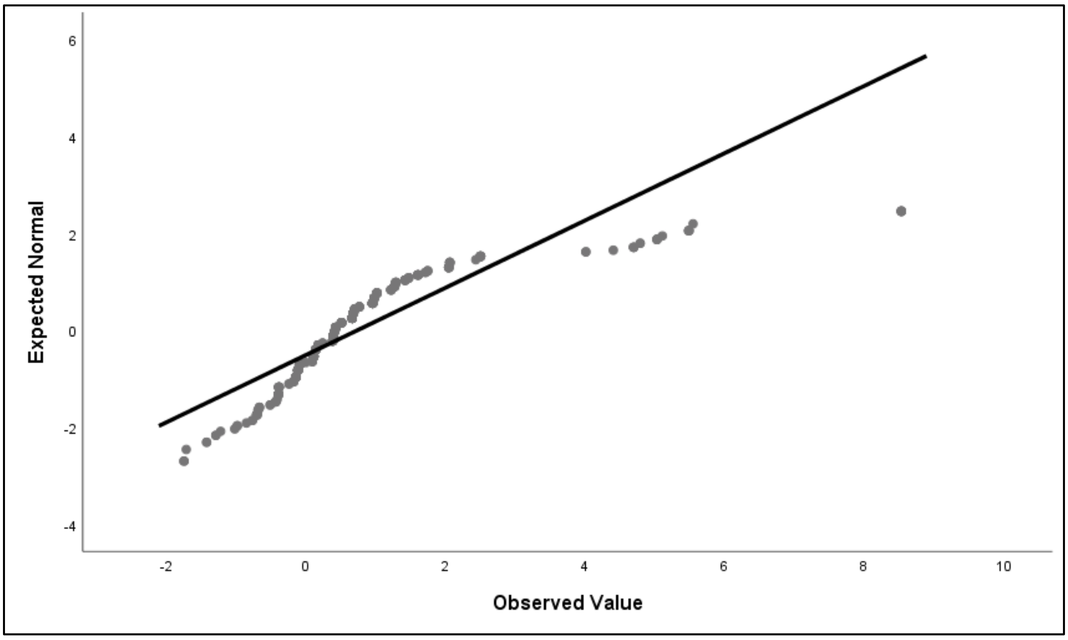


Figure 7.10: Overall mean teacher *d'* within school comparison

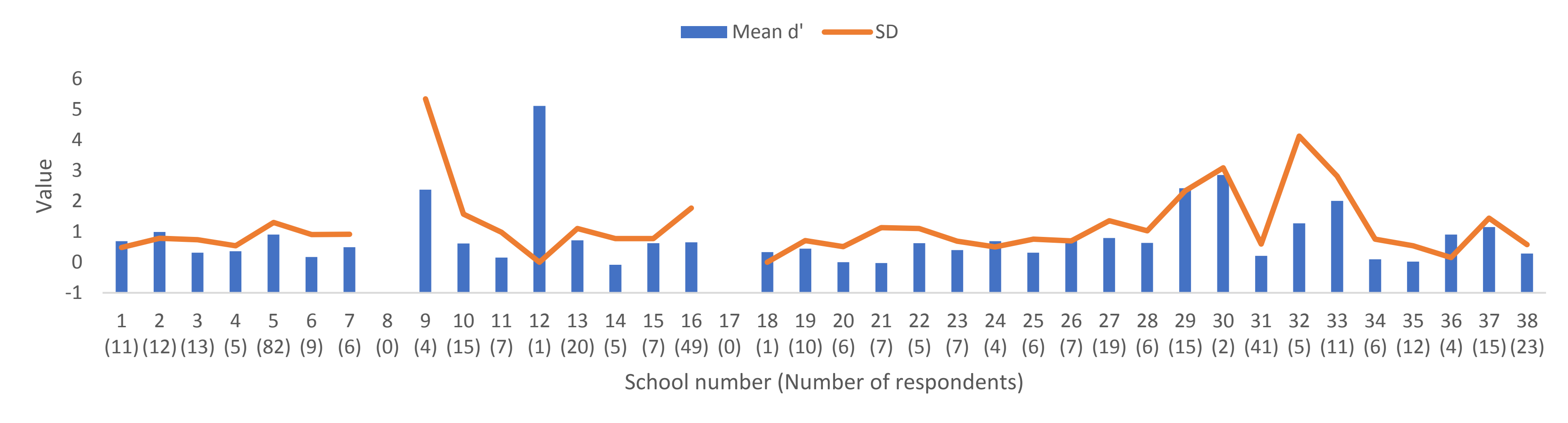
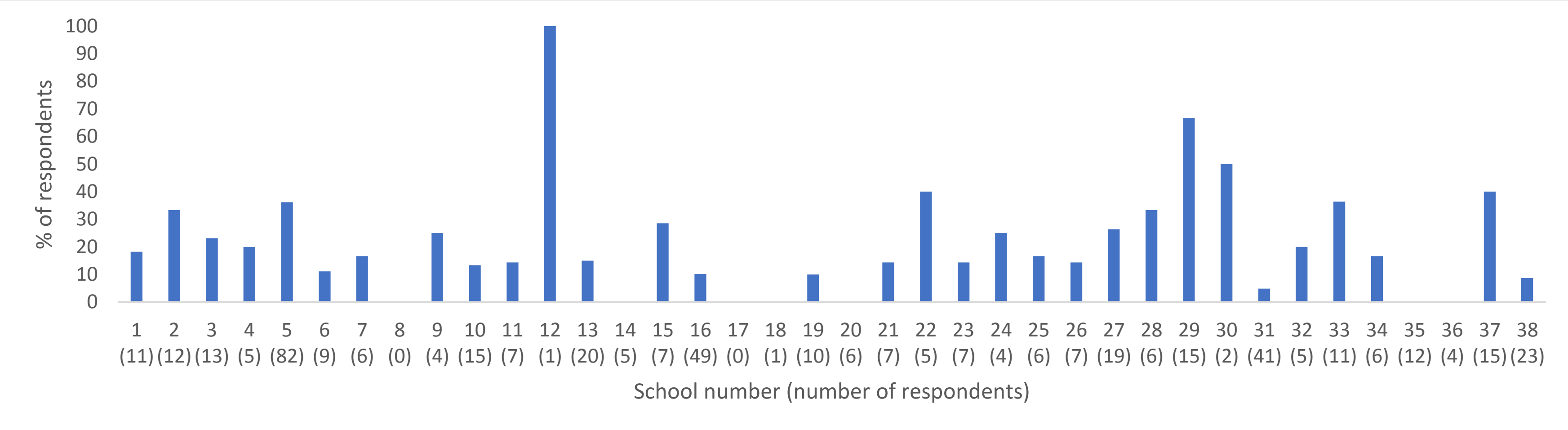



Figure 7.11. Percentage of respondents from each school who achieved *d'* >1.01



Overall *C* (*M* = .15; *SD* = .50; SE = .02; 95% CI = .10 - .20; range = -2.26 - 4.27) scores revealed that teachers were slightly bias towards reporting Teacher Survey items to be false. A t-test revealed no significant differences in *C* values between QSA (*M* = .14; *SD* = .55; SE = .03; range = -2.26 - 4.27) and QSB (*M* = .17; *SD* = .40; SE = .03; range = -2.06 - 1.87) ($t$ (423) = -.58, $p$ = .56).

Overall mean *C* between schools can be seen in Figure 7.12, which illustrates that all schools held a bias towards reporting items to be false (all mean *C* values > 0). The single respondent from School 12 provided the highest *C* (1.71) and School 37 provided the lowest mean *C* (-0.01). The mean *C* standard deviation within-schools (0.36) was lower than that seen for *d'* scores. Within School 36 and School 30 variation was greatest (*SD* = 1.46 & 1.1, respectively) and the lowest variation was found in School 4 (*SD* = .07).

*C* score distribution also failed the Shapiro-Wilk test ($p < .05$) (skewness = -.14; kurtosis = 8.69). Figure 7.13.1 depicts several outliers; one participant reported all items to be false (*C* = 4.27), two reported 16 (of 18) items to be true (*C* = -2.26). All three outliers were from School 5 as likely expected because they provided the most Teacher Survey responses (*n* = 83). The boxplot interquartile tells us that 50% of scores were within .41, suggesting a dense cluster of scores. Figures 7.13.2 & 7.13.3 illustrate that the cluster is centred around .00 with a handful of outliers at either scale-end. That suggests whilst most participants held little bias, some maintained either a strict (higher scale-end) or liberal (lower scale-end) criterion in reporting items to be true. Figure 7.13.3 further reiterates that, except for the outliers discussed earlier, most central data points sat close to frequencies expected of a normally distributed data set. Data distribution for *d'* and *C* across factor one and two will now be described individually and presented visually through histograms. Supplementary Q-Q and boxplots can be seen for each variable in Appendix 11.

Figure 7.12. Overall mean teacher *C* within school comparison

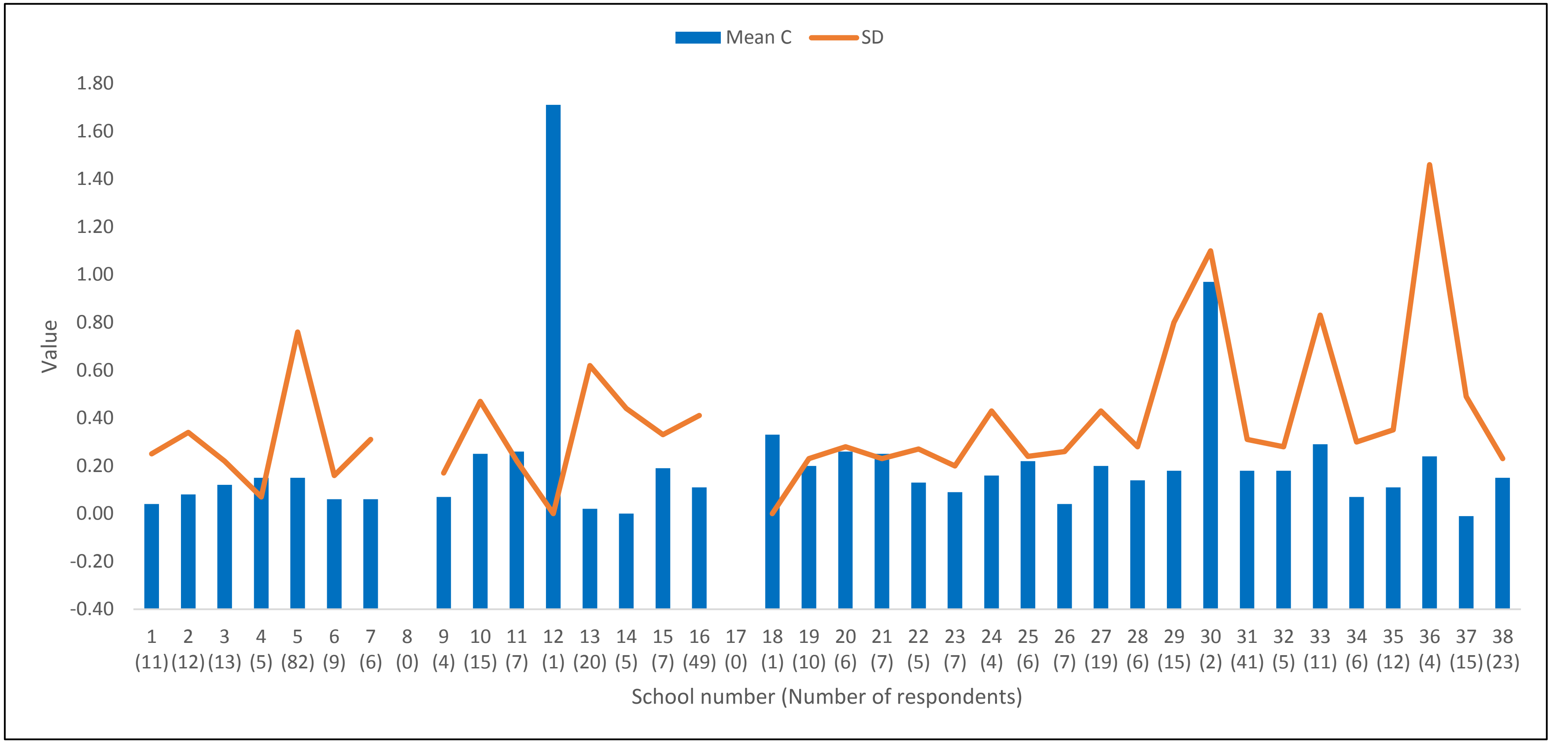


Figure 7.13.1. Boxplot for overall *C* scores

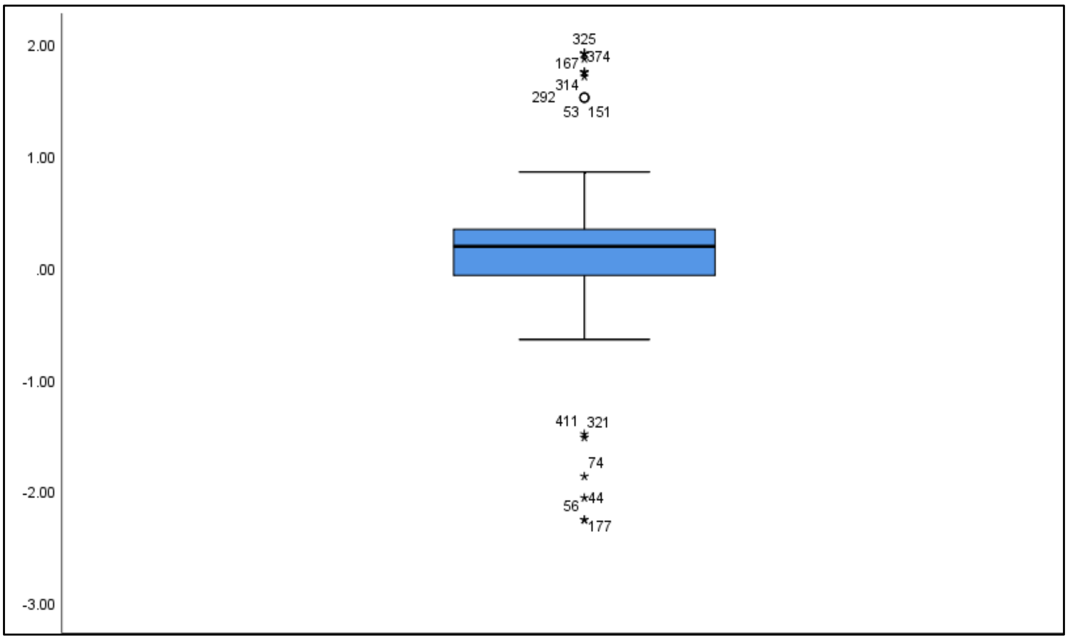



Figure 7.13.2. Overall *C* scores histogram

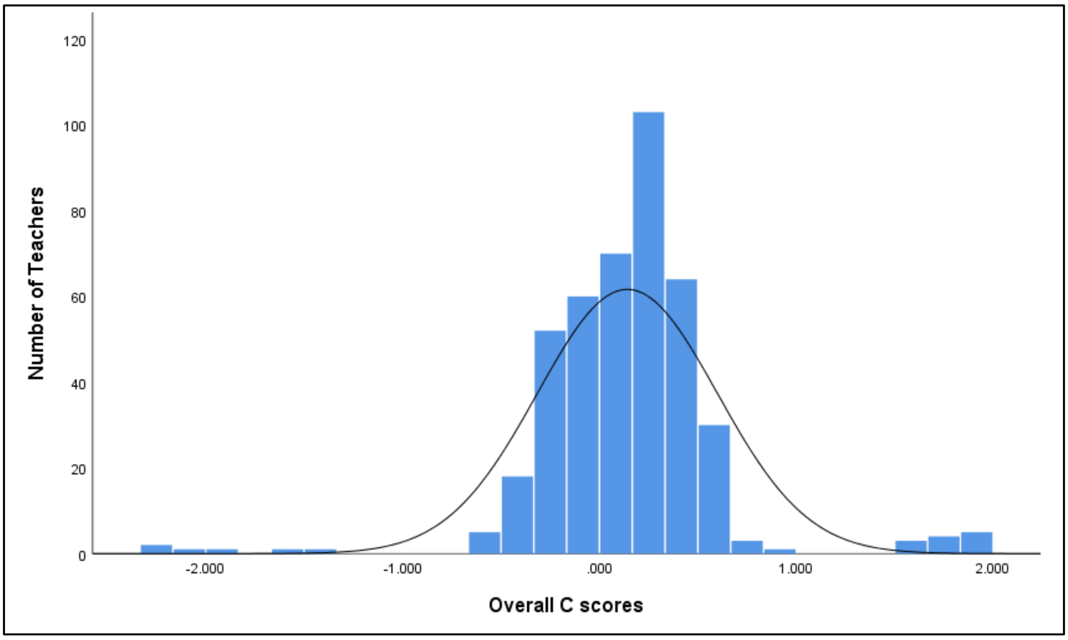
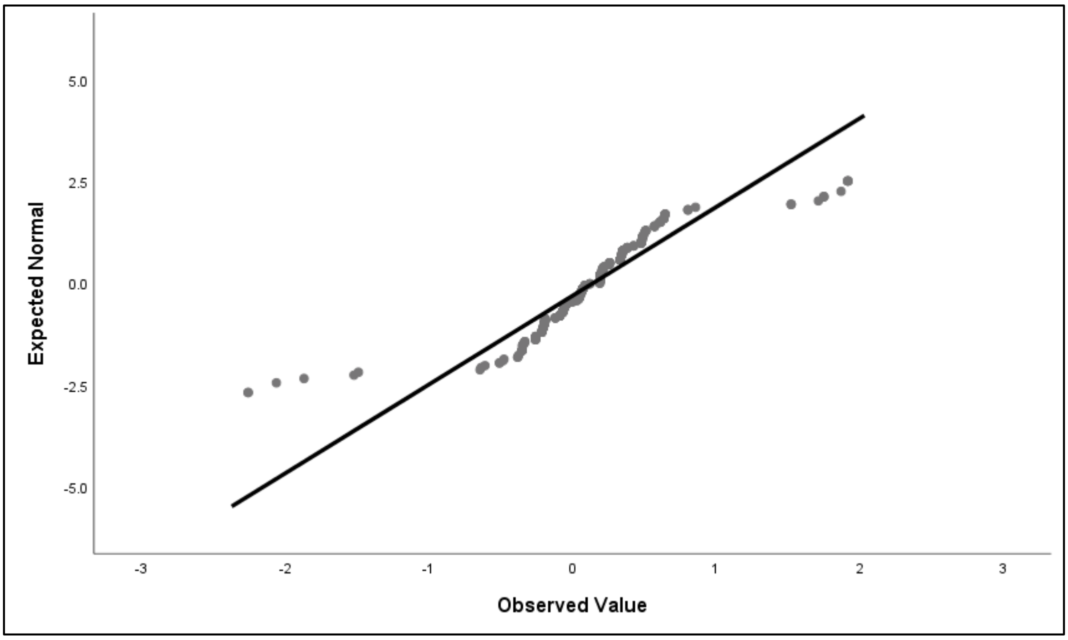
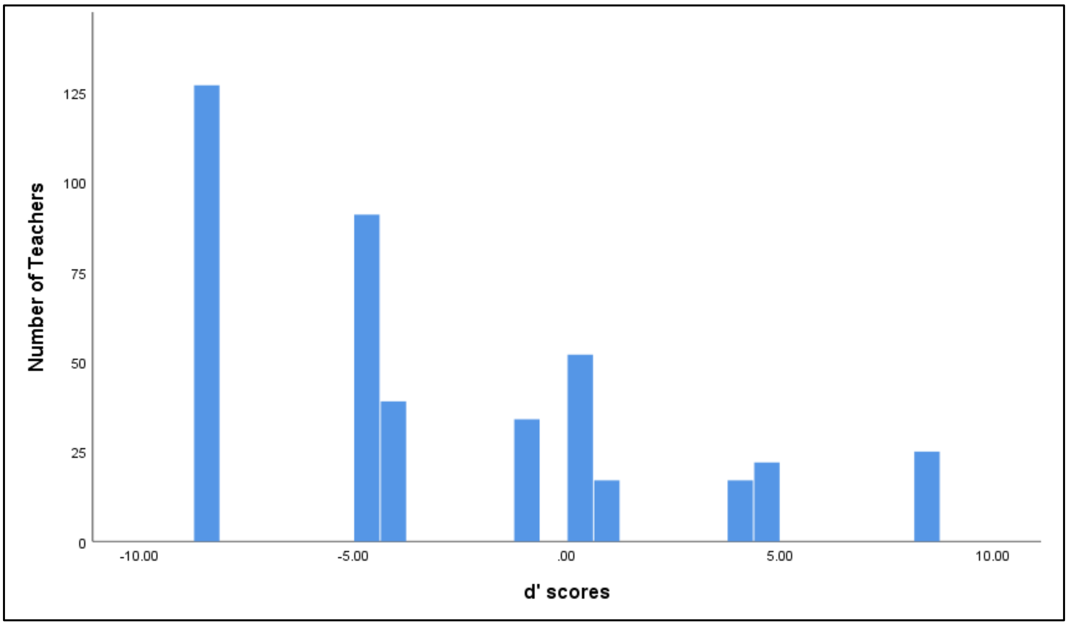


Figure 7.13.3. Overall *C* scores Q – Q plot



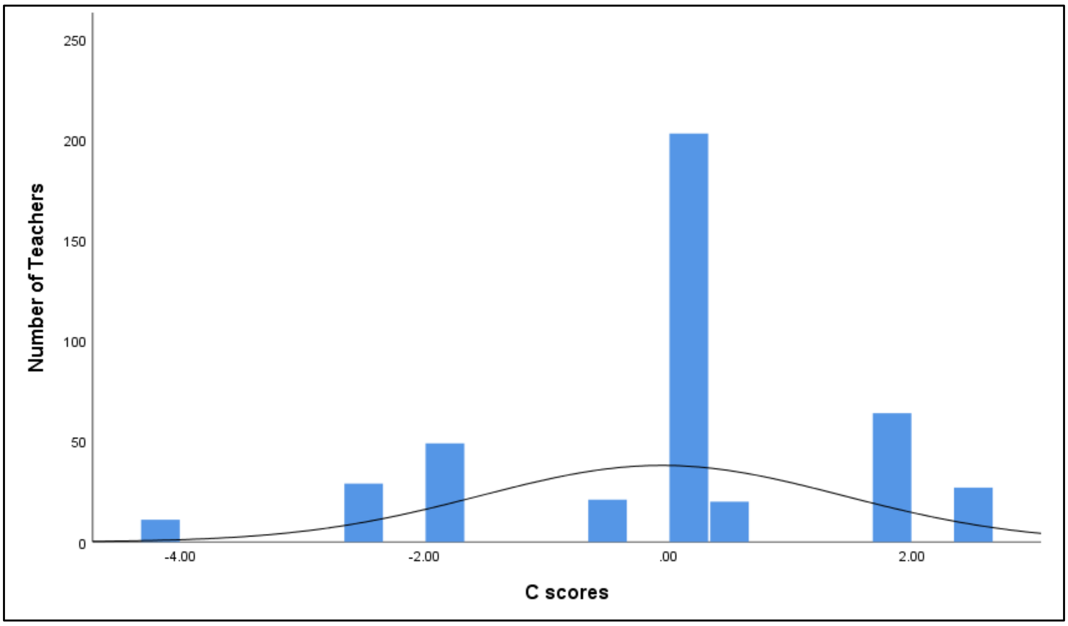

For factor one (i.e., neuromyths), *d'* values suggest that respondents broadly lacked sensitivity (*M* = -3.04; *SD* = 4.97; SE = .24; 95% CI = -3.51 - -2.57; range = -8.53 – 8.53) thereby suggesting that most participants were unable to correctly identify neuromyths. However, the broad range and high standard deviation suggest substantial variation amongst respondents; for example, 26 teachers (from 16 schools) responded correctly to all factor one items whereas 128 teachers (from 23 schools) answered all factor one items incorrectly. Factor one *d'* scores failed the homogeneity test ($p < .05$) (skewness = .70; kurtosis = -.32) and are depicted within Figure 7.14 where data points deviate from frequencies expected particularly around the mid- and upper-scale regions.

Figure 7.14. Factor one *d’* scores



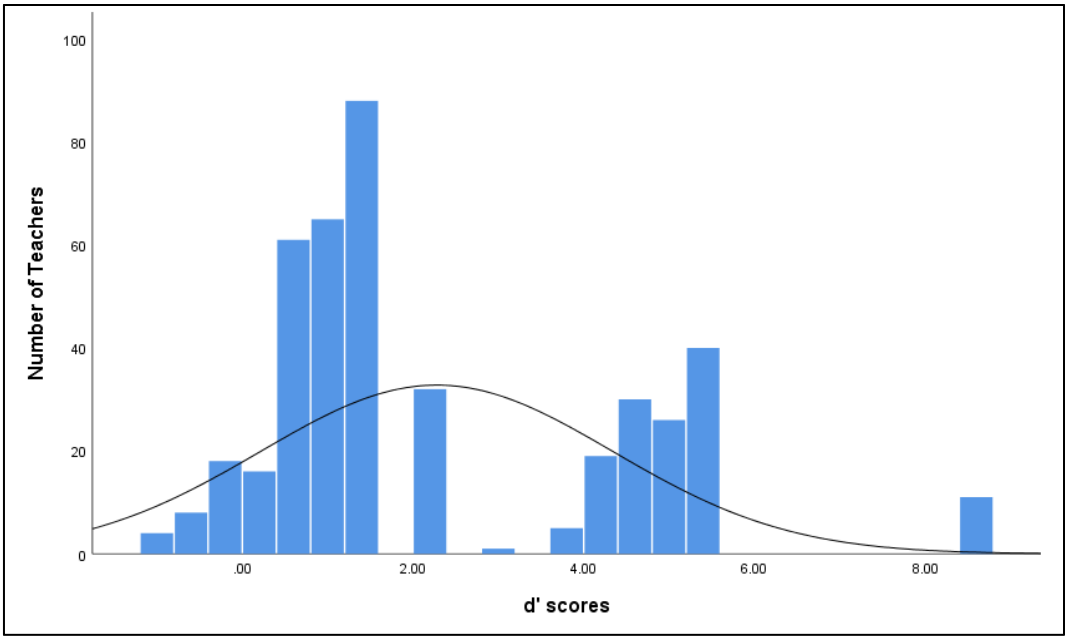

Factor one *C* values suggest that most participants held slight bias towards reporting neuromyths to be true (*M* = -.04; *SD* = 1.50; SE = .07; 95% CI = -.19 - .10; range = -4.26 – 4.26). Shapiro-Wilk’s test of homogeneity again failed ($p < .05$) (skewness = -.45; kurtosis = .31). Notably, 12 low scoring outliers (*C* = <4) spread across five schools were identified who each reported all factor one items to be true. The tall peak in Figure 7.15 illustrates that *C* scores clustered around .00.

Figure 7.15. Factor one *C* scores



Factor two *d’* values suggest that participants were substantially better able to identify well-established, research-based teaching principles than neuromyths ($M$ = 2.27; $SD$ = 2.07; SE = .10; 95% CI = 2.07 - 2.47; range = -1.15 – 8.53). With that said, only 12 participants (each from a different school) identified all factor two items correctly. The three poorest performing participants also each from different schools responded correctly to only four factor two items. The lower standard deviation suggests less variation in participants’ ability to identify factor two items than factor one. *d’* scores for factor two also failed the homogeneity test ($p < .05$) (skewness = .95; kurtosis = .27). Figure 7.16 depicts two clusters of *d’* scores; the first contains most participants and sits between *d’* = 0 – 2 and the second sits between *d’* = 4 – 6. Those who responded correctly to all factor two items (*d’* = 8.53) can be seen on the far-right of the histogram.

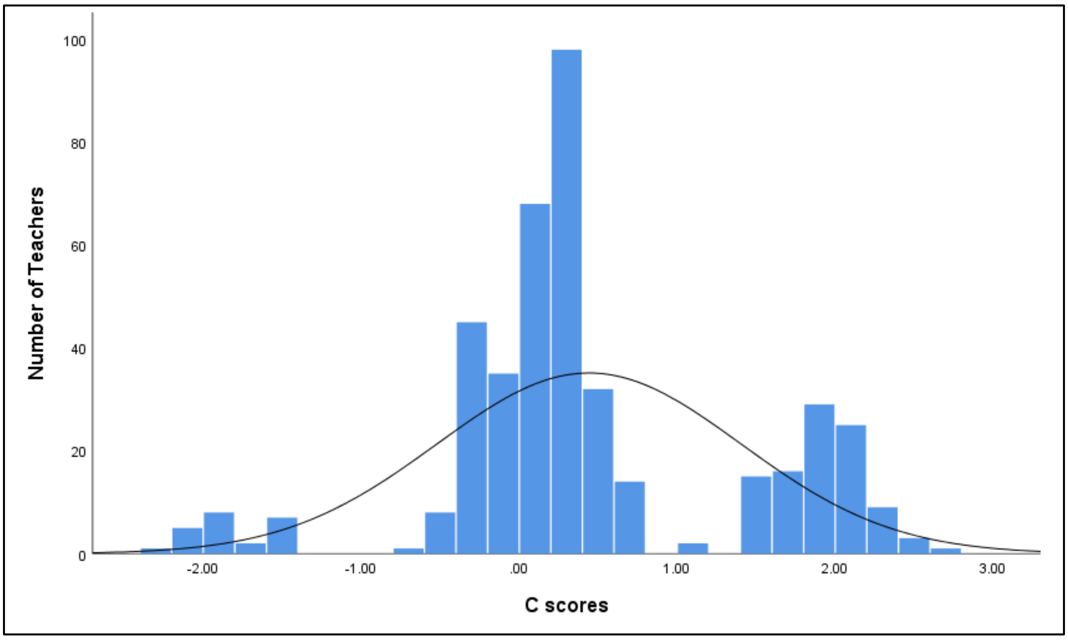
Figure 7.16. Factor two *d’* scores




Factor two *C* values suggest that participants were more conservative; maintaining a higher criterion for reporting items to be true than for factor one *(M* = .45; $SD$ = .98; SE = .05; 95% CI = .36 - .54; range = -2.35 – 4.26). Factor two *C* scores failed Shapiro-Wilk’s test of homogeneity ($p < .05$) (skewness = -.07; kurtosis

= .30. Although outliers can be seen in Figure 7.17, particularly at the lower scale-end, they are less extreme than observed in factor one.

Figure 7.17. Factor two *C* scores




Two Spearman's Rho correlations (due to non-normal data distribution) were conducted to identify the relationship between *d'* and *C* scores across factor one and two. Expectedly, a statistically significant positive correlation was revealed between *d'* scores across factors ($r$ (423) = .16, $p$ < .01) although the correlation is perhaps weaker than expected. Essentially, respondents who were more sensitive to neuromyths (i.e., factor one items) were consistently slightly more sensitive to well-established, research-based teaching principles (i.e., factor two items). For participant *C* scores across factors, a further Spearman's Rho correlation revealed no significant relationship ($r$ (423) = .03, $p$ = .16). Essentially, there was no correlation between participants' liberalism across factor one and factor two.

Several Mann-Whitney U tests were conducted to identify differences in *d'* and *C* across both factors for Teacher Survey respondents compared to School Survey respondents who also responded to the Teacher Survey. School Survey respondents ($n$ = 21; $M$ = 1.06; median = .76) achieved statistically significantly higher *d'* than non-School Survey respondents ($n$ = 404; $M$ = .72; median = .41) ($U$ =

5455, *p* = .03), however, there was no significant difference in overall bias (i.e., *C*) (*U* = 4013, *p* = .08).

For factor one, School Survey respondents (*n* = 21; *M* = -.12; median = .00) again achieved significantly higher *d'* scores than Teacher Survey only respondents (*n* = 404; *M* = -3.19; median = -4.70) (*U* = 5455, *p* <.01). Significant differences were also observed in bias, with Teacher Survey only respondents (*n* = 404; *M* = -.01; median = .00) holding a higher criterion for reporting items to be true than School Survey respondents (*n* = 21; *M* = -.67; median = .00) (*U* = 2788.50), *p* <.01). For factor two, no significant differences were observed in either *d'* (*U* = 4812.50, *p* = .11) or *C* (*U* = 4761, *p* = .13).

In summary, some items (e.g., Practice 2) were accurately responded to by almost all participants (*M* correct responses across variations = 95.75%), whereas Brain Training 2 was responded to accurately least regularly (*M* correct responses across variations = 23.7%). These extremes were reflected across the topics as respondents appeared most familiar with Practice items (91.9% average across four item variations) and least familiar with Brain Training items (24.5% average across four item variations). A factor analysis revealed two dimensions to Teacher Survey: Section Two; broadly, factor one encapsulated neuromyths and factor two consisted of well-established, research-based teaching principles.

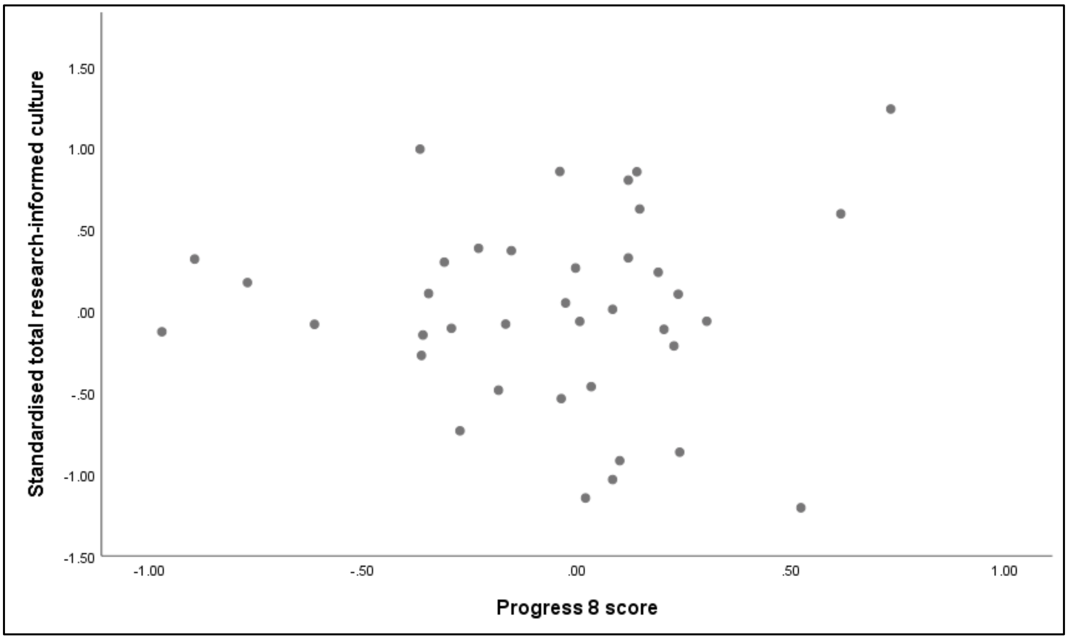
Overall *d'* scores revealed that respondents were usually little more sensitive than would be expected by chance, although there was broad variation within- and between-schools. Using an arbitrary threshold, only 23.06% of respondents would be considered 'research-informe*d'*'. Based on a single response, one school had a 100% rate of 'research-informe*d'*' teachers using that threshold. Another school failed to provide any responses meeting that threshold. *d'* values further suggest that respondents were substantially and more consistently more sensitive to correctly identifying factor two items than factor one items. *C* scores revealed that respondents held a bias towards reporting items as being false (i.e., a stricter criterion for reporting items to be true) with less variation than observed for *d'*. That bias was predominantly driven by factor two items where respondents held notably higher criterion for reporting items to be true than factor one items.

Correlational analyses revealed: a) a positive (but weak) relationship between respondent sensitivity across factors, and b) no relationship between bias across factors. Further analyses revealed that respondents who were also responsible for teachers' professional development achieved significantly higher *d'* scores than their peers for factor one items and overall. No significant differences were observed for factor two.

**7.2.4 RQ5: What is the relationship between: a) the research-informed teaching cultures of secondary schools, b) teachers' awareness of well-established educational research findings, c) teachers' perceptions about research usefulness, and d) student achievement?** This section has been structured to enable visualisation of the relationships cited between each of the variables in RQ5. Aligning with the structure of this chapter, the relationship between student achievement and research-informed culture will be discussed initially, followed by that with teachers' perceptions about the usefulness of educational research findings for guiding practice, and teachers' sensitivity & bias to well-established, educational research findings. Based on a visual inspection, subsequent analyses are conducted to identify the extent and nature of relationships.

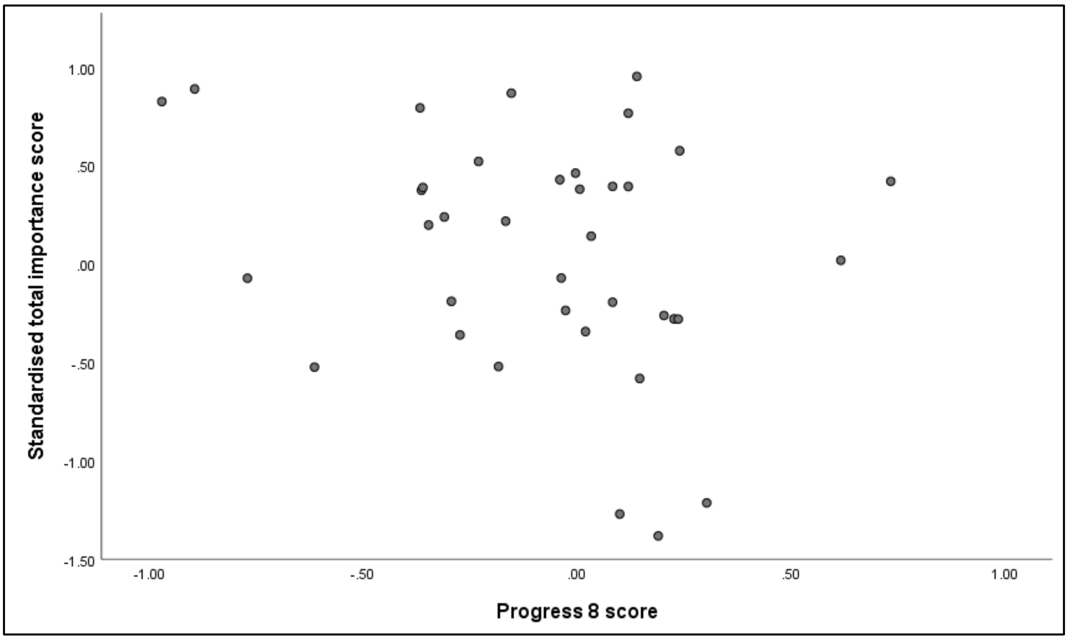
***Research-informed culture vs. student achievement***. Based on Figure 7.18 there do not appear to be either: a) any obvious outliers, or b) a clear relationship. A Pearson's correlation, chosen because data across both variables was normally distributed, verified that there is no statistically significant relationship between each school's standardised total-research-informed score and mean Progress 8 score ($r$ (36) = .02, $p$ = .17). An independent samples t-test revealed no significant differences in Progress 8 scores between schools with above and below average standardised research-informed culture ($t$ (36) = -.33, $p$ = .22).

Figure 7.18. Relationship between each school's standardised research-informed culture score and mean Progress 8 score



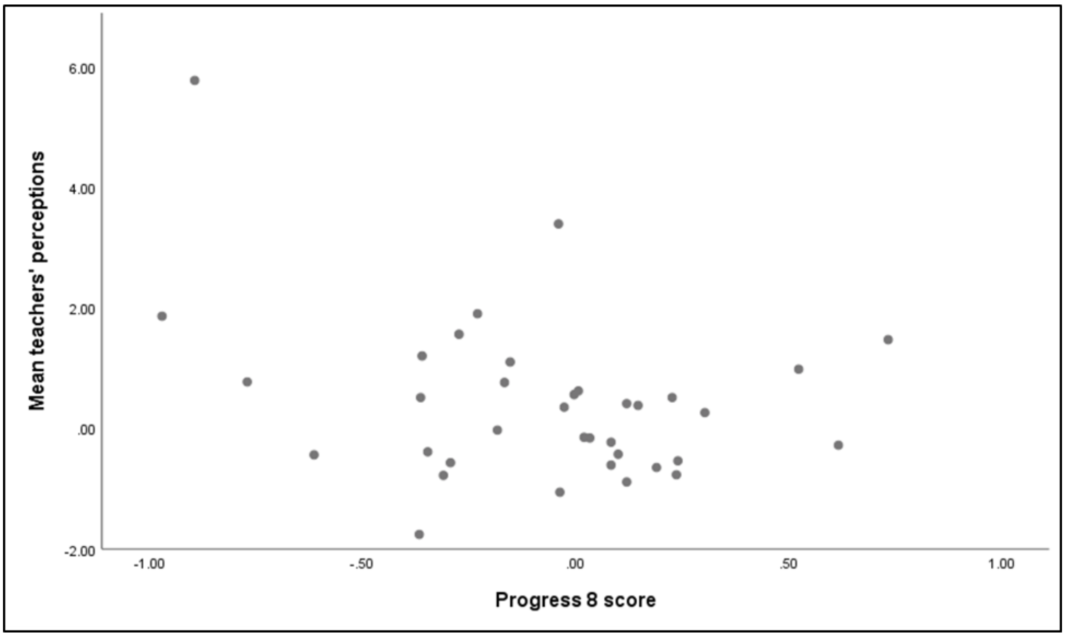

The reader may remember that School 36 was removed from analysis using the standardised total importance scores variable as it was a negative outlier which compromised the data distribution. Using the remaining schools, a Pearson correlation was conducted revealing no statistical relationship ($r$ (35) = -.11, $p$ = .28). That outcome is supported by Figure 7.19 which illustrates little resemblance of a relationship between the two variables. An independent samples t-test revealed no significant difference in Progress 8 scores between schools with above and below mean standardised total importance scores ($t$ (35) = .75, $p$ = .11).

Figure 7.19. Relationship between each school's standardised total importance score and their Progress 8 score



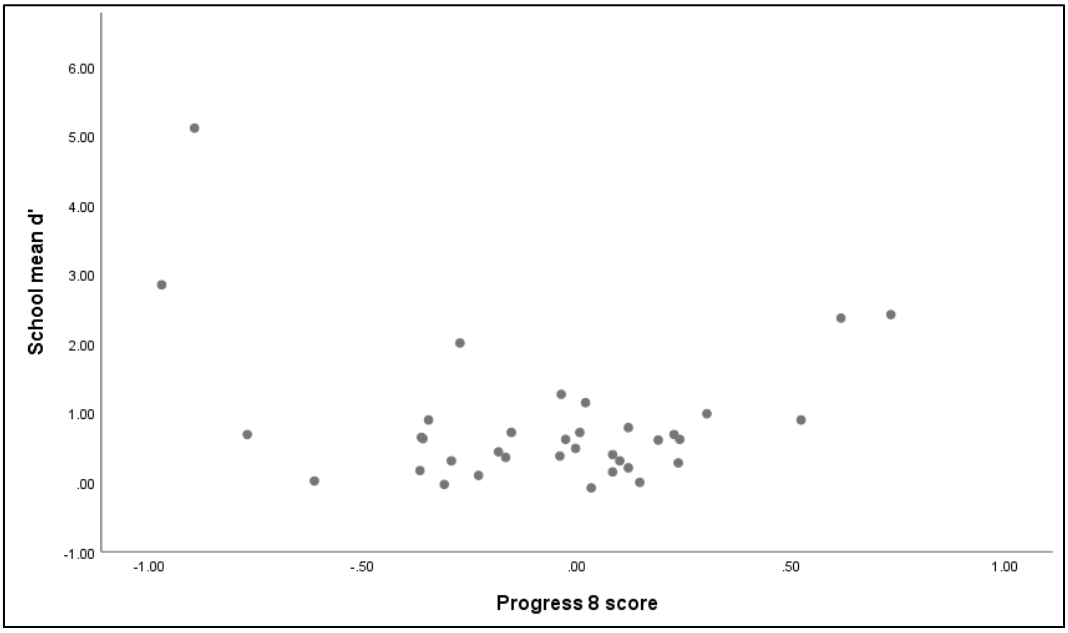

***Teacher attitudes towards research vs. student achievement**.* A Spearman Rho correlation revealed no significant relationship between the mean of teachers attitudes towards educational research within schools and school Progress 8 score ($r$ (36) = -.21; $p$ = .12) (Figure 7.20). School 12 is a clear outlier but excluding it from analysis has no substantial influence ($r$ (35) = -.14, $p$ = .17). An independent samples t-test revealed no significant difference in Progress 8 scores between schools with above- and below-mean teacher attitudes towards educational research scores ($t$ (34) = .71, $p$ = .15).

Figure 7.20. Relationship between each school's mean teacher attitudes towards the usefulness of educational research and mean Progress 8 score



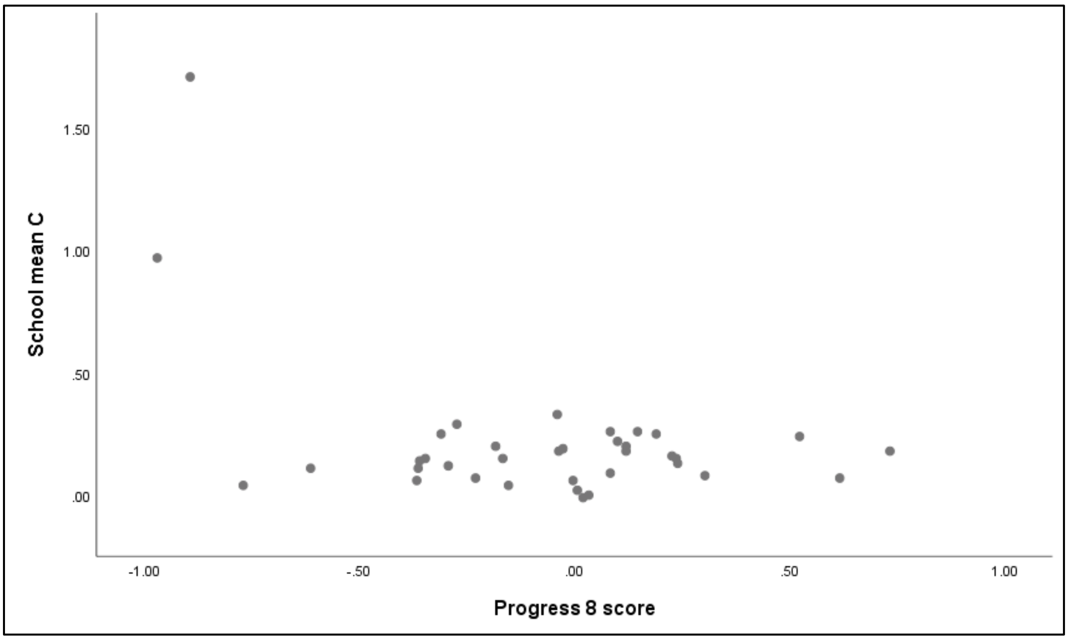

***d' and C vs. student achievement***. Figure 7.21 highlights several potential outliers, but a decision was made to retain all data because the school sample was relatively small. Spearman's Rho correlations were utilised as *d'* values were not normally distributed revealing no statistically significant relationship between school mean *d'* score and Progress 8 score ($r$ (36) = .05, $p$ = .14). An independent samples t-test revealed no significant differences in Progress 8 score between schools with above- and below-mean *d'* scores ($t$ (34) = -.75, $p$ = .07).

Figure 7.21. Relationship between each school's mean *d'* and Progress 8 score




School 12 and School 30 provided anomalously high mean *C* scores as depicted in Figure 7.22. As *C* scores were non-normally distributed, a Spearman Rho correlation was again conducted and revealed no statistical relationship between the two variables with all cases included ($r$ (36) = .01, $p$ = .18). With the two outliers removed, the correlation remained non-significant. An independent samples t-test revealed no significant differences in Progress 8 scores between schools with above- and below-mean *C* scores ($t$ (34) = .70, $p$ = .11).

Figure 7.22. Relationship between each school's mean *C* and their Progress 8 score




To summarise, comparative and correlation analyses revealed zero statistically significant relationships between all independent variables and Progress 8 scores. These analyses reinforce Appendix 12 which depicts the discussed variables and similarly suggests that there is no clear relationship between the variables in discussion.

## 7.3 Additional Analysis

**7.3.1 RQ2: To what extent are the teaching practices of secondary schools research-informed?** Perhaps expectedly based on that school's high standardised research-informed culture score, the 15 Teacher Survey respondents from school 29 had a mean *d'* of 2.42 (*SD* = 2.33; 95% CI = 1.18 - 3.66; range = .18 – 8.53) which, as will become clear, is substantially above average. In contrast, the four respondents from School 36 (which received the lowest standardised total research-informed culture score) had a substantially lower mean *d'* at .90 (*SD* = .15; 95% CI = .65 - 1.14; range = .67 - .98).

Spearman Rho correlations revealed no significant relationship between each school's standardised total-research-informed score and the average *d'* ($r(36) = -.04$, $p = .17$) or attitudes towards research usefulness ($r(36) = .10$, $p = .12$) of the teachers within. Kruskal-Wallis tests reinforced those findings revealed no significant differences in average *d′* ($H$ (1) = .29, $p$ = .19) or teacher attitudes towards the usefulness of research ($H$ (1) = .04, $p$ = .23) between schools with above- and below-mean standardised research-informed culture scores. Similarly non-significant findings were observed between schools with above- and below-mean standardised total important scores in average *d′* ($H$ (1) = .07, $p$ = .14) and teachers' attitudes towards the usefulness of research ($H$ (1) = 1.66, $p$ = .10).

Further analyses compared the *d′* and *C* score of School Survey respondents who also completed the Teacher Survey against the mean of Teacher Survey respondents within each school. Wilcoxon signed-rank tests revealed no significant difference between the related pairs for either *d′* (Z = -.85, $p$ = .12) or *C* (Z = -1.41, $p$ = .10). Essentially, the person responsible for teachers' professional development in each school had similar knowledge of well-established research-based findings to teachers.

**7.3.2 RQ3: What perceptions do teachers hold about the usefulness of using educational research to guide practice?** A Kruskal-Wallis test revealed that respondents' job title had a significant effect on their attitudes towards the usefulness of educational research ($H$ (4) = 20.09, $p$ < .01). Pairwise post-hoc comparisons with Bonferroni adjustment revealed that the significant differences ($p$ < .01) lay only between Assistant/ Deputy Headteachers ($n$ = 33; $M$ = .42; median = .44) and: a) Classroom Teachers ($n$ = 231; $M$ = -.08; median = -.04), and b) Head of Dept/ Head of Year ($n$ = 103; $M$ = .01; median = .06). Further Kruskal-Wallis tests revealed no significant differences in attitudes towards the usefulness of educational research between teacher: a) subject specialisms ($H$ (8) = 3.27, $p$ = .09), number of years teaching experience ($H$ (4) = 1.79, $p$ = .13), and age ($H$ (4) = 9.29, $p$ = .08).

**7.3.3 RQ4: To what extent are teachers aware of well-established, educational research-based findings?** Kruskal-Wallis and pairwise post-hoc comparisons tests were conducted to identify differences in overall *d′* and *C* across teacher demographic variables. If significant differences were revealed, analysis took place to identify whether those differences were driven by factor one and/or factor two. A teacher's subject specialism had a significant impact on overall *d′* ($H$ (8) = 36.12, $p < .01$) and that was driven by factor one *d′* ($H$ (8) = 28.08, $p < .01$). No significant differences observed for factor two *d′* ($H$ (8) = 14.97, $p = .12$). Pairwise post-hoc comparisons (with Bonferroni adjustment) revealed that the significant differences ($p < .01$) lay between teachers of physical sciences ($n = 70$; $M = 1.16$; median = .97 ) and: a) teachers of maths ($n = 72$; $M = .43$; median = .39), and b) PE/ performing arts ($n = 73$; $M = .30$; median = .11).

Significant differences were also observed in overall *d′* between respondents with different highest qualifications ($H$ (3) = 10.02, $p < .05$). Differences were driven by factor two *d′* ($H$ (3) = 7.86, $p < .05$) with no significant differences observed for factor one *d′* ($H$ (3) = 7.04, $p = .07$). Pairwise post-hoc comparisons (with Bonferroni adjustment) revealed that the significant differences ($p < .05$) lay between respondents with a PhD ($n = 10$; $M = 1.73$; median = 1.14 ) and those who have achieved undergraduate degrees only ($n = 47$; $M = .55$; median = .39). No significant differences were found in overall *d′* between respondent: a) job title ($H$ (5) = 5.47, $p = .14$), age ($H$ (4) = 7.46, $p = .12$), and number of years teaching experience ($H$ (4) = 2.00, $p = .20$).

For overall *C*, Kruskal-Wallis tests revealed significant differences between teachers of different ages ($H$ (4) = 10.13, $p < .05$). Differences were driven by factor two *C* scores ($H$ (4) = 12.84, $p < .05$), no significant differences observed between groups for factor one ($H$ (4) = 3.05, $p = .15$). Pairwise post-hoc comparisons (with Bonferroni adjustment) revealed that significant differences ($p < .05$) lay between respondents aged 61+ ($n = 7$; $M = .99$; median = .50) who had a significantly higher criterion for reporting items to be true than those aged 21 – 30 ($n = 91$; $M = .23$; median = .09).

Significant differences were also observed in overall *C* scores between teachers with teaching experience ($H$ (4) = 15.73, $p < .01$). Again, these differences were driven by factor two ($H$ (4) = 12.60, $p < .05$) with no significant differences observed for factor one ($H$ (4) = 4.77, $p = .09$). Pairwise post-hoc comparisons revealed that significant differences ($p < .05$) lay between respondents with 8 – 11 years of experience ($n = 74$; $M = .61$; median = .39) who demonstrated a significantly higher criterion than those with 4 – 7 years of experience ($n = 74$; $M = .17$; median = .07). These findings may suggest that teachers become more cautious in reporting well-established, research-based teaching principles to be true with age and experience. Further Kruskal-Wallis tests revealed no significant differences in overall *C* between respondent: a) subject specialism ($H$ (8) = 10.14, $p = .06$), job title ($H$ (5) = 2.63, $p = .10$), and highest qualification ($H$ (3) = .32, $p = .19$).

**7.3.4 RQ5: What is the relationship between: a) the research-informed teaching cultures of secondary schools, b) teachers' awareness of well-established educational research findings, c) teachers' perceptions about research usefulness, and d) student achievement?** Univariate correlational analyses previously discussed suggest: a) a significant negative correlation between % of students eFSM and Progress 8 mean score, and b) no significant correlation between Progress 8 mean score and:

a) School mean *d'*
b) School mean *C*
c) Standardised total research-informed culture
d) Standardised total importance scores

However, those analyses cannot identify whether Progress 8 mean scores can be predicted by any combination of the above variables, hence a hierarchical multiple regression here. A hierarchical approach was used as it enabled variables to be entered into the model in an order determined by the researcher. Two separate 'blocks' were created; in the first, % of students eFSM only was included because it has a statistically significant negative correlation with Progress 8 mean scores. By including it in the model as a covariate, the variance in student achievement that it explains can be identified. The second block included the remaining exploratory predictor variables listed above and used a stepwise method because we cannot be sure about the predictive power of each variable.

Several assumptions are made in regression analyses. Figure 7.23.1 illustrates normally distributed residuals. No multicollinearity was verified through both: a) VIF statistics for each predictor variable being close to 1 (range = 1 - 3.78), and b) all correlations within the provided matrix being <.80. No autocorrelation and independence of errors was confirmed through a Durbin-Watson test statistic of 1.97. The Durbin-Watson test identifies whether adjacent residuals are correlated, and a statistic of close to two provides assurance that this assumption has not been violated (Field, 2007). There is no requirement when conducting a regression analysis for predictor variables to be normally distributed. As depicted in Figure 7.23.2, the assumption of homoscedasity was met because there appears no clear pattern in the scatter.

Figure 7.23.1. P-P plot illustrating normally distributed residuals

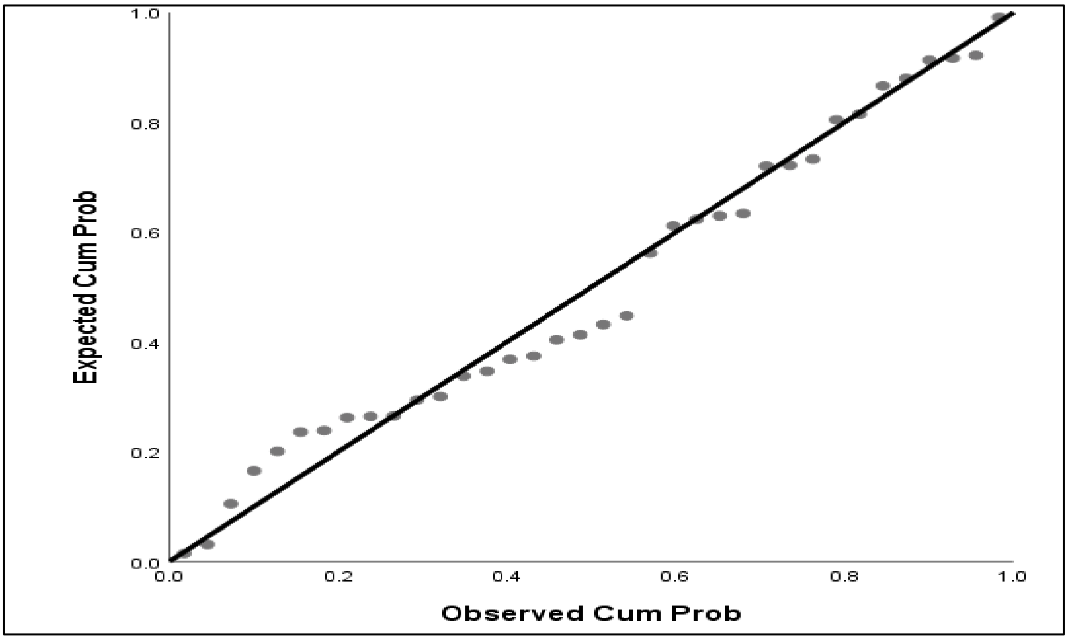
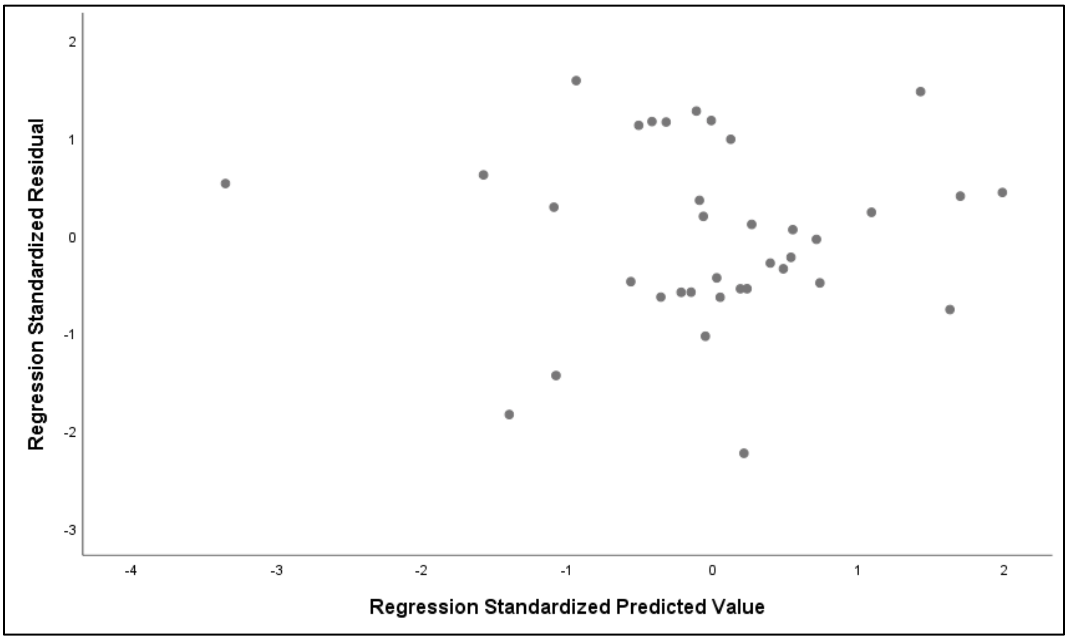


Figure 7.23.2. Scatterplot illustrating homoscedasity




Three models were developed (Table 7.3, below). Model one included only % of students eFSM and revealed a statistically significant regression equation ($F(1, 34) = 17.16$, $p < .01$, $R^2 = .34$, $R^2_{Adjusted} = .32$). From this, we can deduce that 34% of school student achievement is accounted for by the % of students eFSM and, had this model been derived from the population rather than the recruited sample, then we would expect 32% of variance in student achievement to be accounted for. The slope coefficient of -.02 suggests that Progress 8 mean scores reduce by .02 with each increased % of students eFSM.

Model two included % of students eFSM and standardised total importance scores and was also statistically significant ($F(2, 33) = 12.97$, $p < .01$, $R^2 = .44$, $R^2_{Adjusted} = .40$). The slope coefficient for standardised total importance scores was -.17, thereby suggesting that .01 increase in the importance schools place on developing a research-informed culture results in a .17 decrease in Progress 8 mean score.

Model three included both above variables along with each school's mean *C* scores and was again a statistically significant predictor of Progress 8 mean scores ($F(3, 32) = 11.11$, $p < .01$, $R^2 = .51$, $R^2_{Adjusted} = .46$). Notably, though still statistically significant, the deteriorating F-values suggest that model one best fitted the data.

The slope coefficient for mean *C* scores was -.35 meaning that an increase of .01 in mean *C* scores was equal to a .35 reduction in Progress 8 mean scores.

The variables not mentioned were not included because they did not statistically significantly contribute. In a nutshell these models tell us that schools which: a) have higher % of students eFSM, b) place greater importance on developing a research-informed culture, and c) held a higher criterion for reporting educational research findings to be true, endure lower Progress 8 mean scores. With that said, *B* statistics in each model reveal that the biggest influencer in Progress 8 mean scores is consistently % of students eFSM.

Table 7.3. Regression models

| | | *b* | SE (*b)* | *B* |
|---|---|---|---|---|
| Model one | | | | |
| | Constant | .39 | .12 | |
| | % of students eFSM | -.02 | <.01 | -.58** |
| Model two | | | | |
| | Constant | .35 | .12 | |
| | % of students eFSM | -.02 | < .01 | -.54** |
| | Standardised total importance score | -.17 | .07 | -.33* |
| Model three | | | | |
| | Constant | .37 | .11 | |
| | % of students eFSM | -.01 | < .01 | -.47** |
| | Standardised total importance score | -.15 | .07 | -.28* |
| | Mean *C* score | -.35 | .16 | -.28* |

* $p < .05$, ** $p < .01$

## Chapter Eight: Discussion & Conclusion

This chapter will begin by briefly reiterating the research problems investigated before sequentially : a) summarising findings obtained for each RQ, b) comparing them to previous research, c) offering some explanations for conflicting findings, and d) discussed implications for the relevant agencies (e.g., policy-makers, researchers). The methodology adopted throughout this investigation will then be critically evaluated; particularly addressing how it may influence weighting that should be allocated to this investigation's findings. To conclude, some directions for future research will be offered which both: a) address the identified limitations of, and b) utilise the progress made through this investigation.

### 8.1 Summary of research problem(s)

Movements towards developing research-informed education have been ongoing for decades and are largely motivated by assumptions that said approach will improve student achievement. That drive is evident from communications through educational policy and subsequent implementation of mechanisms (e.g., EEF) to increase the production and uptake of educational research 'useful' for guiding teachers' practice. Theoretically, teachers' awareness and appropriate use of educational research findings will improve their practice and consequently student achievement.

Despite policy-makers' ongoing++ enthusiasm for research-informed education, debate lingers amongst academics and teachers about the extent to which research-based knowledge can guide teachers' practice. That debate is partly a consequence of uncertainty about types of knowledge teachers utilise when practising (see Chapter Four) and whether research can create compatible knowledge. Currently, little evidence exists about teachers' knowledge of well-established educational research findings and the relationship between being research-informed and student achievement. This study was conducted to contribute to the inconsistent and/or thin body of knowledge addressing the value of the research-informed education drive.

A logic model capturing the path that knowledge takes from conception to impact on student achievement was developed and guided the construction of RQs. Thirty-eight mainstream state-funded secondary schools partnering EHU participated. The methods used included a literature review (RQ1), a survey distributed to the person responsible for teachers' professional development within each school (RQ2), a survey distributed to all willing teachers within each school (RQs 3 & 4), and statistical analyses to identify a relationship between survey data and GCSE achievement (RQ5).

## 8.2 RQ1: Has educational research created a robust body of knowledge that is relevant for teachers' practice?

Academics (e.g., Hargreaves, 1996; Goldacre, 2013) and policy-makers (e.g., DfE, 2016) have criticised educational researchers for failing to provide consistent knowledge which is built upon methodologically robust research and useful for guiding teachers' practice. Until recently little research has explicitly and comprehensively tested both claims. The two authors to be discussed in the remainder of this paragraph have cited 'knowledge claims' but the robustness of the research upon which those claims are formulated is unclear. Levin et al (2011) identified knowledge claims of factors influencing student success and trajectory. Though related, the claims cited by Levin et al (2011) are not evidence that educational research can create knowledge that teachers can use in the classroom to raise achievement. Nelson et al (2017) and Boser (2019) have since also reported identifying knowledge claims centring on raising achievement. However, alike Levin et al (2011), teachers only had control over some of the knowledge claims. Problematically, it is difficult to argue that teachers should engage with research which generates knowledge that they can ultimately do little with.

RQ1 fills this gap in literature by identifying well-established educational research findings in the context of teaching principles which can have a direct impact on teachers' practice and raise student achievement. A literature review encompassing several criteria revealed 20 teaching principles, spread across 10 different topics (e.g., feedback), each established through high-quality research as yielding consistently enhanced student achievement when incorporated into teachers' practice. Based on the literature review, the proposition that educational research can create knowledge useful for guiding teachers' practice and subsequently raising achievement is accepted. Encouragingly, there was some overlap between the knowledge claims identified by Nelson et al (2017) and Boser (2019), and those identified here thereby reinforcing the notion that educational research is fit for this purpose. Nelson et al (2017) also established that ability grouping is ineffective for raising achievement of all learners whereas homework can be an effective mechanism for raising achievement. Boser (2019) identified the positive impact of metacognition, retrieval practice, and spaced practice. The lack of consensus in identified well-established educational research findings between Nelson et al (2017) and the current investigation can be explained. Nelson et al's (2017) study was conducted across primary and secondary settings therefore knowledge claims they identified were necessarily applicable to teachers across settings, this investigation targeted only secondary school teachers. Secondly, unlike the current investigation, Nelson et al (2017) included knowledge claims which are unlikely to directly influence teachers' practice as have little relevant control (e.g., 'Drinking six to eight glasses of water per day improves pupil learning outcomes')

Due to criteria imposed during the literature review, research accessed shared several characteristics (e.g., primarily experimental/ quasi-experimental) but it also demonstrated that educational research can: a) conceive and describe teaching principles, b) test their effectiveness in a fairly robust way, and c) communicate them to teachers. Several obstacles were identified during that process and will be discussed moving forward.

Firstly, as discussed in section 6.3, few research methods facilitate cause (i.e., implementation of teaching principle) and effect (i.e., enhanced student achievement) to be established. Those methods necessitate strict controls to maximise internal validity and sometimes, despite researchers' efforts, are detrimental to external and ecological validity. To account for such limitations and reinforce the claim that each teaching principle is well-established, relevant meta-analyses were sought. Controls imposed exasperate the limitations of educational research and, because of the strict controls often imposed, Hanley et al's (2016) proposition that the 'what works' agenda may be better understood as 'what works but for whom and under what circumstances' seems valid. As an aside, some research methods have been formulated to address such issues; for example, meta-analyses often report 'moderating' variables which affect the strength of relationships between variables. There are important implications here particularly for teachers because whilst wanting research which illustrates 'what works' (e.g., Gore & Gitlin, 2004; Ratcliffe, 2005) and seeing educational research utilisation as an important step to evidence-based education (see section 7.2.2 – item 9B), they have also demonstrated relatively low research literacy (e.g., Nelson et al, 2017). Consequently, some teachers may have an insufficient understanding of educational research to appreciate methodological limitations and tools available to correct those limitations.

Secondly, and building on Huat-see et al (2016), further evidence was obtained here (see section 7.2.2 – item 9A) that teachers believe educational researchers often provide insufficient descriptive detail to enable accurate replication of principles by teachers. In addition, only a minority of the investigations identified during the literature review explicitly implemented treatment fidelity checks (see section 6.5). Together, these issues leave teachers being encouraged to use research-based principles without clear instruction or assurance that findings have been acquired using the principle as originally conceived by the researcher. Failure to provide sufficient descriptive detail may reflect some disparity in the values of educational research between researchers and teachers. Perhaps in acknowledgment of such problems, Hammersley (2005) appealed for educational research to be used as an informative tool rather than a recipe for teaching. His proposal may, however, simply serve to confuse matters for teachers who are encouraged to turn to educational research for 'answers' and are doing so with increasing enthusiasm.

Thirdly, teachers (e.g., Cain, 2016a; current investigation (section 7.2.2 – item 10B)), academics (e.g., Hargreaves, 1996), and policy-makers (e.g., DfE, 2016) have each cited concern about inconsistencies in knowledge generated through educational research. Countering those concerns, Levin et al (2011), Nelson et al (2017), and the current investigation report having identified largely uncontroversial research-based knowledge. Notably, evidence provided by Levin et al (2011) and Nelson et al (2017) to support their knowledge claims as being uncontroversial is thin compared to the current study. Beyond the teaching principles identified in this study, evidence of inconsistencies in educational research findings was observed even amongst research which met the instated criteria, and several explanations (e.g., treatment fidelity) have been provided (see section 6.5).

Similar problems were observed within practitioner texts where educational research findings were communicated as being robust. However, inspection of the investigations upon which those claims were based revealed a less clear picture about their consistency (section 6.4.2). Essentially, educational research findings were sometimes conflated, simplified, and misrepresented in practitioner texts. Conflation and simplification may be necessary for some methodological reasons and to facilitate communication in a language accessible to teachers.

Misrepresentation, however, is more concerning and compromises authors' integrity. To provide an example, in reinforcing direct instruction to be an effective strategy, Hattie (2009) discusses Fischer and Tarver's (1997) meta-analysis which found 'effects close to $d = 1.00$' (p. 207). Though ostensibly accurate, Fischer and Tarver's (1997) findings are anomalously strong and they acknowledge several caveats from their findings, both of which are omitted by Hattie (2009). For example, upon inspection, most studies within their analysis used learners in SEND settings with those utilising mainstream primary and secondary school aged children revealing negative effect sizes ($d = -0.12$). Fischer and Tarver (1997) found great variation in effect sizes (95% CI's $d = 0.25 – 1.77$) and report that 'just two of the 27 interventions had effect sizes of $d = 1.00$ or greater' (p. 77) both of which included only SEND learners. Additionally, included investigations delivered lessons electronically via different instructional software therefore observed differences may simply reflect the effectiveness of that software. Those intricacies have important implications because based on Hattie's (2009) discussion, policy-makers and SMT would likely promote direct instruction but closer inspection would reasonably result in more caution.

For teachers and policy-makers, inconsistencies in research findings are problematic and explanations for those inconsistencies will be of little immediate benefit. In the long-term, explanations may filter through to teachers and policy-makers and contribute to their research literacy thereby enabling those agents to make better judgements about the value of educational research in a given scenario. However, in the meantime, teachers will continue being encouraged to use findings from a body of knowledge, of which only some is consistent, to guide their practice.

If researchers accept the role of providing uncontroversial knowledge, then the supporting evidence should be transparent and open to scrutiny from peers and teachers. Though a problematic proposition, that is achievable only through explicit illustration. Firstly, interrogation of knowledge claims would both increase and change demands on the relevant agencies (i.e., teachers, policy-makers, peers). Secondly, debate about whether knowledge is uncontroversial is wedged in an epistemological debate in which, as discussed through Chapter Three, disagreement remains. To reiterate, some commentators (e.g., Cook, 2004) argue that governments hold knowledge derived from comparative research methods in higher-esteem than that derived from case-study research, for example. Supporting evidence can be seen in the EEF Toolkit's (2018) stipulation that only research inferring cause-and-effect is considered. Comparison of the teaching principles put forward here against those promoted by the EEF is difficult because the latter do not provide 'definitive claims about what will work' (EEF, 2019). However, there is some overlap as both promote: a) provision of homework, b) raising student metacognition, and c) feedback in raising achievement. Similarly, both cast doubt about the usefulness of ability grouping and aligning teaching strategies with student learning styles to raise achievement.

Disagreement about the type of research-based knowledge upon which teachers should guide their practice also seems prevalent within practitioner texts.

Some (e.g., Hattie, 2009) are driven purely by statistical conventions based on the outcome of quantitative research. Others (e.g., Marland, 2002) appear to be largely driven by anecdotal evidence based on the sparsity of academic references (18 references in total, of which seven are government papers). Marland (2002) is a 147-page text and makes no claims about the basis underpinning discussion, it simply states that it was 'planned to assist the professional development of secondary-school teachers... to improve their practice further' (p. iv).

Borg (2006) illustrates that some teachers see practitioner texts as educational research and, as highlighted in this investigation, some fit that classification. However, given teachers' often low research-literacy (Nelson et al, 2017), they may be unable to discriminate between those based on robust research and those not. Consequently, teachers may take guidance from practitioner texts under the false premise that they are: a) necessarily research-based, and subsequently b) developing research-informed practice. Though beyond the scope of this study, inconsistency teachers report in educational research findings may be partially attributable to disparity between practitioner texts which communicate evidence-based knowledge and those which communicate other (e.g., anecdotal) knowledge.

## 8.3 RQ2: To what extent are the teaching cultures of secondary schools research informed?

RQ2 was developed to identify the extent to which mainstream state-funded secondary schools have established a research-informed culture and the importance they placed on developing that culture. In discussing strategies schools can take to develop such cultures, Brown and Greany (2018; p. 3) argue that 'there has been little research undertaken to provide an evidence base on effective evidence use'. Cain (2018) has since created a five-construct (i.e., distributed leadership, support for individuals and groups, whole-staff involvement, partnerships with external bodies) framework which, he argues, represent effective approaches for developing school research-informed cultures. In turn, research utilisation can improve teachers' practice by informing their decision-making, challenging their mindsets, and developing schools as intelligent learning communities (see section 3.3). A survey designed to tackle each construct within Cain's (2018) framework was distributed to the person responsible for teachers' CPD within each school.

Representativeness of recruited schools against those locally (i.e., north-west England) and nationally was verified using several demographics (e.g., % of students eFSM) (see section 7.1.1). Consequently, generalisability of obtained findings can be made across mainstream state-funded secondary schools with some confidence though there are some limitations. Firstly, only schools in partnership with EHU participated and it is conceivable that schools in HE partnerships are an anomalously enthusiastic subgroup about research-informed education and, perhaps consequently, may have a more established research-informed culture.

Secondly, generalisability of findings about the development of research-informed cultures may not be transferrable across other educational institutions (e.g., primary schools). With that said, Cain's (2018) framework was developed using research involving primary schools, secondary schools, and FE colleges. Hence, the constructs are likely transferrable, but assumptions should not be made across about the state of research-informed cultures and the importance placed on developing them. Coldwell et al (2017) provide evidence that the concept of a research-informed culture is stable across institutions, making several explicit references about similarities between primary and secondary schools with highly research-informed cultures. For example, middle-leaders in both settings share some similar responsibilities (e.g., leading research learning communities). Similarly, chapter authors throughout *An Ecosystem for Research-Engaged Schools: Reforming Education Through Research,* are largely indiscriminate in discussing dimensions of research-informed schools between educational institutions. There is also some evidence that policy-makers also see little reason to discriminate between primary and secondary school settings in driving research-informed education. For example, the Carter Review (Carter, 2015) made several recommendations for improving educational research utilisation and subsequent mechanisms (e.g., EEF Toolkit, 2018) were implemented to target both primary and secondary schools as a result.

The representativeness of school-survey respondent professional demographics against those in similar positions nationwide could not be verified because data for the latter was not publicly available. Though likely of little significance, it was investigated because the level of seniority at which the person(s) in that position is placed may have indicated the seriousness with which the respective school was driving towards becoming research-informed (EDT, 2015).

High internal consistency of the created School Survey demonstrated that all items contributed to the same construct (i.e., development of a research-informed culture). Some schools provided two school-survey responses and, despite having obtained face and construct validity, intra-school agreement was varied perhaps indicating that items (e.g., phrasing) and/or the constructs being measured were not clearly defined. Inconsistency predominantly emerged from items about the importance of each construct. Problematically, importance allocated to each construct is subjective to some extent because responses will likely be based on interpretation of interactions (both implicit and explicit) with colleagues and SMT as well as that person's understanding of the wider-context of driving research-informed education. That gap could be bridged by exploring the motivation behind respondent perceptions. Further tackling issues surrounding the subjective nature of some School Survey items and providing further evidence of the created School Survey reliability, it would be useful to identify the stability of participant responses over time (i.e., test-retest). For policy-makers and SMT, it is important that researchers clearly define the concept, determinants, and worth of a research-informed culture. Without that clarity, the knowledge created surrounding school research-informed cultures is difficult for policy-makers to utilise and promote. Similarly, it is equally difficult for SMT to justify allocation of already-tight school funding to implementing steps to develop said culture without clarity.

The remainder of this section will address the findings corresponding to each construct within Cain's (2018) framework. Direct comparison of findings against previous research using Cain's (2018) framework was difficult due to its recency however, as highlighted in section 3.3, several authors have made similar claims thereby facilitating less direct comparison.

**8.3.1 Distributed Leadership**. The role of SMT in creating and serving as a primary thrust towards developing a research-informed culture has been widely emphasised (e.g., Handscomb & Macbeath, 2003; Dimmock, 2016; Cain, 2018; Brown & Greany 2018). Broadly, they agree that developing a research-informed culture necessitates SMT: a) creating a vision were research-based evidence is valued for improving practice, b) establishing school-wide structures to facilitate that vision, and c) transmitting that vision to all teachers. Reinforcing the important role of SMT, Dagenais et al (2012) found that teachers are unlikely to use educational research when SMT do not drive it.

Here, SMT reportedly valued and used educational research in ways integral to school development; for example: a) to guide implementation of new initiatives and creation of policy, and b) promote a culture of reflectivity and creativity (see section 7.2.1 – item 10). Those findings also reinforce Coldwell et al (2017) and Handscomb and MacBeath (2003); the latter highlighting necessity for SMT to make educational research integral to school policy and practice. Furthermore, promoting teachers' use of educational research to enhance reflection and creativity may indicate acceptance that educational research is best used to raise questions about practice (i.e., conceptual research utilisation) which more closely aligns with current academic thinking (e.g., Cain, 2016b).

As discussed in section 3.3, Cain (2018) argues that SMT can demonstrate a research-orientation and promote developing schools as intelligent learning communities by distributing aspects of leadership. Dimmock (2016) makes a similar point, arguing for formal research-focused roles within schools (e.g., research lead's). In this study, less than half of schools reported having a research lead ('or equivalent') which may reflect SMT unwillingness to distribute leadership and authority. Alternatively, it may either: a) reflect the relatively reduced importance (compared to other items) respondents reported in having this type of role, or b) be a product of fiscal pressure as reported by the EDT (2015). Regardless of the explanation, this finding perhaps indicates the seriousness of school leaders' endeavour to develop schools as intelligent learning communities. Though beyond this investigation, it may be worth identifying the seniority at which those roles are placed and the authority they are afforded. To explain, the EDT (2015) found that most Research Leads were middle-managers but were most influential when levelled with SMT. However, Brown and Greany (2018) note that middle-managers can play a pivotal role within schools, but only when afforded authority and support by SMT.

**8.3.2 Support for individuals.** Building on questions raised about SMT's drive to develop schools as intelligent learning communities in the previous section, this investigation also identified that the provision of resources facilitating teachers' research engagement are inconsistent. Approximately one-quarter of schools failed to offer any of the listed mechanisms to support teachers' research engagement (e.g., allocated research time). Furthermore, access to academic resources, research-focused training, and access to a research mentor were provided by little over one-third of schools (see section 7.2.1 – item 4). These findings both reinforce teachers' complaints about lacking access to educational research (e.g., EEF, 2016; Everton et al, 2002) and contravene the necessity to 'make available and coordinate time and the space and budget required for teachers to engage' with educational research (Brown & Greany, 2018; p. 11)

Failure to provide academic resources may be attributable to SMT's awareness of difficulty that teachers consistently report in understanding educational research (e.g., Borg, 2009; Nelson et al, 2017). However, this explanation may have been more fitting prior to the development of mechanisms (e.g., open access policy, EEF Toolkit (2018)) which make accessing academic resources physically and intellectually easier. Furthermore, SMT awareness of teachers' said difficulty would not excuse failure to provide access to a research mentor or research-focused training.

Despite providing few resources, respondents were highly enthusiastic about encouraging teachers to use educational research to challenge their conceptions about T&L and placed substantial importance on it. Consequently, teachers will perhaps necessarily utilise informal means (e.g., social media) to become research-informed, subsequent concerns about that approach will be discussed in section 8.4. Essentially, the findings in this section provide evidence that some schools are encouraging teachers to become research-informed but failing to provide adequate resources.

Problems of lacking resources are aggravated as almost half of schools offered zero quality assurance procedures to ensure that research engaged with meets academic standards (e.g., high-quality, robust). Problematically, knowledge acquired from research engaged with is likely to subsequently be communicated to colleagues through formal (e.g., CPD events) and informal (e.g., dialogue) means. Indeed, as mentioned earlier educational research is commonly used as a basis for initiatives implemented and policy created. Consequently, there is a real possibility that those initiatives and policies are being informed by knowledge acquired from texts constructed lacking sound academic foundations.

**8.3.3 Support for groups.** As discussed in section 3.3.3, academics (e.g., Cain, 2018; Brown & Greany, 2018; Handscomb & Macbeath, 2003) agree that SMT should establish environments enabling collaborative teacher research engagement (e.g., 'professional learning communities' (Dimmock, 2016)) to flourish. For Cain (2018), collaborative research engagement can encourage professional dialogue amongst teachers about the research process and impact on practice. Respondents appeared to be aware of the importance of provoking professional dialogue as they commonly reported that groups of teachers (e.g., departments) are encouraged to use educational research findings for that reason and to influence their decision-making (section 7.2.1 – item 6). Broadly speaking, schools reported placing substantial importance on driving both approaches. However, problems noted previously following insufficient provision of resources prevail here, too.

To reiterate, Cain (2018) found a common and seemingly successful approach to developing collegiality in research engagement amongst teachers was through development of research reading groups and school-based research conferences. Here, over half of schools reported that zero teachers participate in research reading groups. Whilst we cannot conclude that research reading groups are not advocated and facilitated by SMT, Cain (2018) is keen to point out that when teachers 'buy-in' to the prospect of research-informed education then participation in research reading groups becomes more common.

School-based research conferences and publications took place more regularly for 'some teachers' than research reading groups, participation amongst more than 'some' teachers was rare. Though promising, there is little basis for assurance that research raised at those meetings would be high-quality and/or interpreted accurately because teachers' physical and intellectual access is evidently limited. Perhaps consequently, teachers' implementation of educational research-based evidence is not consistently systematic (Coldwell et al, 2017). Several of the support mechanisms (e.g., allocated research time) discussed thus far would likely help make teachers' use of educational research more consistently systematic. For example, Coldwell et al (2017) and Everton et al (2002) provide evidence that post-graduates report more confidence in utilising educational research.

**8.3.4 Whole staff involvement.** Discussion thus far has focused on the provision of resources and structures for (potentially) only a subgroup of highly-motivated teachers. However, Cain (2018) argues that for schools to develop a research-informed culture, all teachers should benefit from research engagement. Brown and Greany (2018) allude to a similar notion suggesting that research-engagement should become a 'cultural norm' or 'part of the way things are done' (p. 9).

Analyses revealed that whole-staff involvement most commonly takes place through regular staff briefings and school-based CPD days (see section 7.2.1 – item 12) both of which will include discussion focusing on topics other than educational research, but they differ in regularity. Staff briefings are traditionally daily (or bi-daily) brief interactions in which customary discussion (e.g., staff absences) prevail. CPD days occupy a few days per year and similarly include discussion on various topics (e.g., safeguarding) but may also include some centring on educational research. The point here is that research engagement amongst some teachers may be only superficial due to the sparsity and/or brevity of the occasions schools use for whole-staff research engagement. This suggestion is reinforced as most schools reported that only some teachers participate in research reading groups, school-based conferences & publications. Perhaps, however, only some teachers partake in those activities because few schools (approximately one-fifth) facilitate them (see Appendix 7A).

Whole-staff involvement can be further promoted by encouraging and facilitating teachers' engagement in post-graduate degrees. Here, a quarter of schools reported offering no support for teachers pursing further education (see section 7.2.1 – item 16) and there are a couple of possible explanations. Firstly, it may simply reflect little value SMT place on teachers' obtaining post-graduate qualifications. An alternative explanation requires some context; prior to 2010 government aspired for all teachers to be Masters-level graduates, however that landscape has changed and the number of teachers studying for Masters courses have reduced perhaps owing to either increased university fees and/or reductions in school-funding (Cain, 2018).

Though whole-school involvement is desirable, it is important that teachers are not coerced into portraying false enthusiasm for becoming research-informed and that may be happening in some cases. Borg (2009) and Dagenais et al (2012) each provide evidence that teachers tend not to address educational research unless specifically required to do so. Furthermore, within Borg's (2009; p. 372) investigation, 213 of 269 teachers engaged with educational research because 'it is good for professional development' and over 20% reported engaging with research because their 'employer expects it' and 'it will help with promotion'. Similar findings were obtained in this investigation, with approximately 30% of respondents reporting that research-engagement is considered professionally desirable (see section 7.2.2 – item 9B). If teachers are being pressed to engage with educational research against their judgement, then research use may be superficial and a source of resentment as seen by Cain (2016a).

**8.3.5 Partnership with external bodies.** Several potential problems consequent to research engagement without appropriate quality-assurance measures have been discussed. Some of those issues can be somewhat allayed through developing and maintaining research-focused collaborations with external bodies (e.g., universities). Coldwell et al (2017; p.8) report that research-engaged schools commonly 'lead or take part in external research projects'. Here, School Survey respondents reported regular contact with external bodies (see section 7.2.1 – item 9). Perhaps consequently, a substantial proportion of dialogue with teachers about their professional development focused on providing opportunities to collaborate in research within- and between-schools (see section 7.2.1 – item 8). Interestingly, despite endorsement from several academics (e.g., Godfrey & Handscomb, 2019) about the role school-HE collaborations can play in developing research-informed cultures, similar opportunities with HEI's were reported less commonly (see section 7.2.2 – item 12). Similarly, Coldwell et al (2017) and, Brown and Greany (2018) found that collaborations with universities were often limited to only the most research-engaged schools.

From practical and logistical perspectives, collaboration within- and between-schools may be easier than with universities, particularly following the introduction of Teaching Schools. The 'self-improving school system' in which 'teachers and schools are required to learn from each other and from research' (Brown & Zhang, 2014; p. 782) will also likely serve as a catalyst for inter-school collaborations. However, Teaching Schools are essentially Ofsted-rated Outstanding schools and do not necessarily possess the research expertise expected of universities. As such, concern remains about the likelihood of obtaining robust research outcomes from those alliances. Furthermore, some Teaching Schools report difficulty in facilitating capacity for research-engagement and maintaining alliances with other schools (Brown & Greany, 2018).

To summarise this investigation's findings for RQ2, little variation was observed overall in the total number of steps schools took to develop a research-informed culture, with most schools sitting close to average and a couple of anomalies at both scale-ends (see Figure 7.4). Analysis seems to suggest that SMT value educational research in informing policy and practice at a high-level (see section 7.2.1 – item 3) and ostensibly encourage teachers to do the same. However, contravening key principles of developing a research-informed cultures put forward by Cain (2018) and, Brown and Greany (2018), schools often failed to implement structures and resources to accommodate meaningful research engagement.

Despite failure to implement mechanisms to drive teachers' research-engagement, respondents quite consistently reported placing high importance on developing constructs of a research-informed culture (see section 7.2.1). Perhaps expectedly, schools reporting greatest importance on developing a research-informed culture also reported implementing more supporting mechanisms (see Figure 7.6.

As discussed in section 3.3.5, Brown and Greany (2018) developed a four-factor framework sharing similarities with Cain's (2018) and distributed a survey measuring their framework to primary schools (most of which utilising RLC's). Interestingly, their analysis revealed a substantially more positive outlook about the extent to which schools implement structures and promote research engagement and utilisation as a cultural norm. Several limitations of Brown and Greany's (2018) research were highlighted and it is perhaps also worth noting that they rarely required respondents to cite specific example of structures implemented to encourage research-engagement (e.g., access to academic literature).

To develop research-informed cultures within secondary schools it seems that external partnerships, particularly with HE settings can play a pivotal role. Indeed, Coldwell et al (2017) report that research-engagement in many schools partaking in collaborations increased during their two-year investigation. However, as pointed out by Cherney et al (2012) and discussed in section 3.2, the relationship between teachers and researchers appear troublesome partly due to their divergent values of, and for, educational research and the questions that each group believe research should be used to answer. Several authors (e.g., Nutley et al, 2007; Nelson & O'Beirne, 2014; Coldwell et al, 2017) have argued for increased school-HE collaboration and some subsequent benefits have been discussed above. However, Cain (2018) rightly notes that forging effective collaborations may necessitate teachers acknowledging that universities may have diverging plans for the direction of research likely driven by government initiatives (e.g., REF) and university department strategies. School-HE relationships could potentially be optimised if built on neutral ground between the institutions in which the goals of, and for, research are closely defined and aligned. Amongst other changes, achieving that goal would likely require a change in government perspective away from current university funding formulae (e.g., REF)

## 8.4 RQ3: What perceptions do teachers hold about the usefulness of using educational research to guide practice?

This RQ was tackled through the Teacher Survey: Section One where all willing teachers within participating schools responded to a series of items collectively designed to gauge their attitudes towards the usefulness of educational research for guiding practice. An abundance of research assessing: a) regularity of teachers' research engagement, b) obstacles teachers face, c) teachers' perceived benefits of research engagement, d) resources teachers use to engage, and d) how teachers use research to influence their practice was explored in section 3.4. As such, this part of the current investigation was largely developed to create confirmatory evidence.

***Teachers value educational research.*** Aligning with the findings of Everton et al (2002), Borg (2009), Nelson et al (2017), and Coldwell et al (2017), teachers here generally reported that they believe educational research findings to be appropriate for guiding practice (see section 7.2.2 – item 9). Alike Vanderlinde and van Braak (2010), Nelson et al (2017), and Borg (2009), teachers in more senior roles (e.g., Assistant/ Deputy headteachers) reported more positive perceptions than their subordinates (e.g., classroom teachers), though all subgroups were generally positive (see section 7.3.2). An explanation for those differences is unknown but several possibilities will be explored.

***Why do teachers value educational research?*** Here, most teachers reported valuing educational research because they believe it can facilitate evidence-based practice and contribute to their ongoing reflection (see section 7.2.2 – item 9B). Though both are somewhat novel findings, they have been reported by Vanderlinde and van Braak (2010), and more recently by Nelson et al (2017). Earlier research often concluded that teachers valued educational research which tackled practical problems that they experience (e.g., Ratcliffe et al, 2005; Gore & Gitlin, 2004).

Those contrasting findings may reflect a swing in teachers' views away from an expectation that research can provide direct solutions to practical problems (i.e., instrumental research utilisation) to acceptance that research is more appropriately used to raise questions and challenge conceptions about teaching practice. The latter of those perspectives more closely aligns with current academic thinking about the importance of research being used to challenge teachers' mindsets. However, it is more likely that contrasting findings reflect an overlap between the three factors with: teachers wanting research which provides evidence-based strategies for tackling practical problems which, they believe, would then be useful and fit to occupy a role in their ongoing reflective processes (e.g., planning).

Considering previous findings that teachers value research using methods aligning with those driven by government (e.g., Ratcliffe et al, 2005; Borg, 2009; Coldwell et al, 2017), enthusiasm about the prospect of research facilitating evidence-based practice may be taken as evidence that teachers are increasingly subscribing to the promises of research-informed education. With that said, there remains a relatively small but seemingly consistent (e.g., Coldwell et al, 2017)) percentage of teachers who perhaps resent being coerced in to engaging with educational research and see research engagement as a 'tick box' exercise, necessary for professional development and career progression (see section 7.2.2 – item 9B).

***How do teachers engage with educational research?*** To engage with research, teachers predominantly reported using informal means (e.g., discussions with peers, social networking), substantially fewer reported utilising academic resources (see section 7.2.2 – item 11). These findings broadly align with those of Beycioglu et al (2010) and Everton (2002), though the latter also reported popularity for 'research' distributed through 'official bodies such as the DfES, the QCA, the TTA and OFSTED' (p. 378). Preference for informal means of research engagement bring some advantages for teachers and researchers but are also potentially problematic. Advantages largely centre on practicality as they facilitate convenience and accessibility. Using social networking as an example, it is likely that teachers will have access to at least one platform which: a) is free, b) can be physically and intellectually accessed with ease, and c) is accessed regularly. This is in stark contrast to research published behind paywalls and requiring substantial time to engage with and understand. Those practical advantages mean teachers can engage with educational research, though to a more superficial extent, in a more time-efficient way and may consequently be more enthusiastic about the prospect of research engagement. Researchers may also benefit as they can disseminate key findings, for example, to a wider audience with less bureaucratic restrictions and obstacles than currently observed in the academic publication process. Although, by-passing the fairly-robust publication process may compromise the integrity and quality of academic literature (Kelly, Sadeghieh, & Adeli, 2014) and increase the likelihood of research findings being conflated, simplified, and perhaps misrepresented. Of further concern, engaging with research further from the point of conception may increase the potential for teachers to be exposed to a less authentic account resulting in the intra-school distribution and utilisation of misinformation.

***Teachers who are more positive about becoming research-informed take more steps to engage with it.*** Expectedly, those who perceived educational research to be more useful also reported taking more steps to maintain research currency (see section 7.2.2). Therefore, developing the thrust of teachers' research engagement may necessitate enhancing their enthusiasm for research-informed education, and that may be achievable by diminishing some obstacles and concerns that teachers consistently report.

There are several agencies that can potentially play a positive role in breaking down those obstacles and collegiality amongst them is likely key. Policy-makers perhaps have the most prominent role, wielding the power to adjust funding to secondary schools thereby enabling school leaders' ability to provide: a) additional time for whole-staff research engagement, b) increased and more useful resources (e.g., research lead's), and c) additional opportunities for research collaborations. School funding has been targeted several times throughout this chapter and because the evidence created here (albeit not the strongest) suggests that SMT's have a desire to develop research-informed cultures within schools. It seems that the 'buy-in' from SMT and most teachers is present and we, as academics, should work to identify and understand why schools do not engage with research more consistently and systematically. The belief here is not that a lack of funding is the sole explanation and there is evidence to support that proposition with some relatively low-cost approaches to developing a research-informed culture (e.g., school-based publications) also often absent.

***What obstacles do teachers face in becoming research-informed?***

Teachers' preference for informal means of research engagement is possibly a product of obstacles which they have consistently reported facing. Such obstacles include a lack of time (e.g., Borg, 2009; EEF, 2016, Coldwell et al, 2017), physical and intellectual access (e.g., Borg, 2009; Nelson et al, 2017), and perceived failure of researchers to address teachers' practical problems (e.g., Gore & Gitlin, 2004). Participants in this investigation differed little with common concerns reiterating lacking time and access (physical and intellectual) to resources, and difficulty implementing educational research findings most commonly due to either insufficient procedural instruction from researchers or contextual factors (e.g., student behavioural challenges) (see section 7.2.2 – item 10B). Some of the highlighted concerns, notably limited time and access, may be partially alleviated through governmental mechanisms (e.g., open access policy) and practitioner texts, however, the previously discussed issues inherent with mediating agencies remain prevalent. Other concerns, such as insufficient provision of procedural detail to enable replication, perhaps again reflect disagreement between agencies about the role of educational research which is a problem more deeply ingrained within the respective professions.

***Why do some teachers believe educational research is not appropriate for guiding their practice?*** The most prominent concerns as raised by over half of participants were about methodologies used in educational research (see section 7.2.2 – item 9A). Such concerns are not new and have historically been raised by academics (e.g., Hargreaves, 1996), policy-makers (e.g., Tooley & Darby, 1998) and teachers (e.g., Lysenko et al, 2014). In this investigation, those concerns often centred on a perception that research methods used in educational research failed to provide generalisable findings and a lack of credibility for researchers without substantial first-hand teaching experience. The former has been discussed for decades and clearly remains a source of discontent amongst teachers. It is particularly interesting that teachers expect generalisable research but also shun research (and researchers) for not understanding unique cultural contexts and specific children in a specific school (working with specific teachers) in a specific community. A lack of credibility for researchers without first-hand teaching experience was touched upon by Hargreaves (1996) who responded to it by encouraging teachers to replicate doctors' regular involvement and 'reach backwards' into research rather than remain as research-consumers.

Further aligning with previous research (e.g., Beycioglu et al, 2010; Cain, 2016a), concern was cited about a perceived gap between theory developed through research and teachers' practice. Debate about the extent to which educational research should be used for the benefit of; a) academics (e.g., through theory construction) as promoted by Hammersley (2005) and Leindhardt (1990), or b) teachers (e.g., by identifying solutions to their practical problems) as encouraged by Goldacre (2013), Hargreaves (1996), and Ion and Iucu (2014) is ongoing and shows little sign of being resolved. Perhaps consequent to concerns about lacking researcher credibility and a gap between research-generated theory and teachers' practice, teachers tend to see research as a 'third voice' (Cain, 2016a) and usually lend substantial weight to it only when it is supported by other forms of evidence (e.g., personal/ peer experience) (Ratcliffe, 2005; Cain, 2018; Nelson et al, 2017).

***To what extent is teachers' practice influenced by educational research?*** Expectedly, there was a significant positive correlation between perceived usefulness of edand influence of educational research on one's practice (see section 7.2.2). Perhaps owing to concerns and obstacles that teachers reported in the previous subsections, they were more reserved about the extent to which their practice is influenced by research findings (see section 7.2.2 – item 10) compared with their perspectives about the usefulness of educational research findings for guiding practice. The possibility that the disparity between teachers reported high value for research and their reservations about using it to influence their practice may be attributable to social desirability bias must be considered.

Similar findings have been obtained by Lysenko et al (2014), Borg (2009), and Nelson et al (2017). Lysenko et al (2014) found that teachers reported using research to influence their practice sporadically, Borg (2009) found that the majority reported only a 'moderate' (p. 739) influence on practice. Though it is useful to understand teachers' perspectives on the extent to which their practice is guided by educational research, Coldwell et al (2017) found that whilst there was 'relatively little evidence... of teachers directly importing research findings to change their practice' (p. 54), research-based evidence more commonly filtered through to influence teachers' practice via processes implemented by SMT who use research-based evidence as a 'springboard for changes' (p. 55).

***How does educational research influence teachers' practice?*** There was substantial variation in the ways teachers used research to influence their practice thereby making the identification of trends difficult. Though not completely clear due to the brevity of responses, many teachers provided replies which ostensibly suggested that they believed research influenced their practice in instrumental ways. Teachers commonly pointed to specific resources utilised or research accessed to develop aspects of practice. Others spoke more vaguely about either research resources and/or aspects of practice which they believed had been directly influenced by research (see section 7.2.2 – item 10A.

Of possible importance, the approach taken here to exploring the influence of educational research on teachers' practice is somewhat unique because whilst many researchers have, perhaps necessarily, explored this phenomenon less directly and few have explicitly identified teacher perspectives. Borg (2009) is an exception but although he asked participants to report the extent to which 'research you read influences your teaching', no detail is provided about participant responses. Previous research has commonly involved case-studies which take the following procedure: teachers are exposed to educational research, research engagement is facilitated by researcher, and inferences are made about how the research has impacted their practice based upon questionnaires (e.g., Lysenko et al, 2014), face-to-face interviews (e.g., Cain, 2015a) and/ or focus groups (Huat See et al, 2016). The findings of said research largely form a consensus that educational research influences teachers' practice through subtle and intricate processes as described by Cain (2018). Indeed, as seen in section 7.2.2 – item 10A, some teachers reported instances of conceptual research here, too.

The contradictory findings between the current investigation and those prior may reflect discrepancies between the perceptions that teachers and researchers hold about the impact of research on teaching practice. To provide a possible explanation, it is worth turning to the 'invisible impact' (Cain & Allan, 2017) of educational research findings. They argue that educational research impacts teachers practice by 'informing decision making at the level of national, local, or institutional policy-making' (p. 719). Therefore, educational research may be more influential in guiding teachers' practice than they appreciate because it has diffused in a long-winded, indirect way by filtering through policy-makers and SMT before they are exposed to it. Indeed, Cain and Allan (2017) provide evidence that direct dissemination of research to policy-makers was substantially more common than to teachers and Coldwell et al (2017) demonstrate that SMT are typically more research engaged and mediate research use within their respective school.

## 8.5 RQ4: To what extent are teachers aware of well-established, educational research-based knowledge?

Following Nelson et al (2017) and Boser (2019), this investigation is amongst the first to identify teachers' awareness of teaching principles which have been consistently established through robust educational research to raise achievement. More commonly, teachers' knowledge of neuromyths has been assessed (e.g., Howard-Jones et al, 2009; Dekker et al, 2012). This investigation identified teachers' knowledge of 20 well-established, research-based teaching principles across 10 different teaching topics (e.g., feedback) identified through a literature review (Chapter Six) and six neuromyths (see section 5.2.3.2). Appropriate reliability and validity (see section 5.3.2) were obtained for the created survey before distribution. Consequently, some confidence can be assumed in the findings being discussed.

Great variety was observed in teachers' ability to identify research-based principles across topics. The brevity of Nelson et al's (2017) survey means that we cannot identify specific topics which explain variance in teachers' research knowledge. Here, most teachers were able to identify research-based knowledge in only some topics (e.g., practice). In other topics (e.g., Brain Training), teachers were rarely able to accurately identify research-based knowledge (section 7.1.3). Seven items were withdrawn prior to main analysis because they failed to: a) contribute to the overall model, and/or b) discriminate between teachers. Zero items were removed because teachers were generally unable to correctly identify them (i.e., too difficult) however, some (e.g., Practice 2) were removed because almost all teachers correctly identified them.

Variation in teachers' ability to accurately identify well-established educational research findings raises questions about why some seem more consistently known than others. Speculatively, variation could be symptomatic of either school-centred, research-centred variables or an interaction between both. School-centred variables may include the weight of importance SMT place on particular principles or the extent to which principles pushed through educational research findings align with teachers' experiences (Levin et al, 2011; Nelson et al, 2017; Cain, 2017). As such, it would be reasonable to propose that SMT may be more inclined to access, accept, and subsequently disseminate across whole-staff educational research aligning with their experiences. Academics broadly accept that teacher experience can and should an important function in effective practice (e.g., Biesta, 2007; 2010) and teachers' willingness to scrutinise research findings is promising. However, to progress research-informed education, research may be better scrutinised objectively (e.g., based on methodological quality and robustness) rather than against teacher experiences.

Variation in teachers' knowledge of educational research findings may also be an effect of research-centred variables, such the previous focuses of educational research. The suggestion here is that conducted educational research may shift to align with that pushed by policy-makers, for example, and increased production of research with a particular focus may lead to increased teacher awareness of established findings in that field. For example, policy-makers have quite intensely promoted the importance of feedback in raising student achievement (DfE 2010, 2013, 2015, 2016). The DfE (2015) produced a report discussing the transition from GCSE grades to levels and mentioned the importance of feedback on 46 occasions. Feedback has also received substantial attention from researchers; for example, Hattie (2009) reports that feedback received the greatest attention of all identified teaching approaches with 23 meta-analyses encapsulating 1287 studies. Perhaps because of extensive exposure, teachers' awareness of well-established feedback principles were amongst the strongest of all topics in this investigation.

Factor analysis revealed that teachers' knowledge of well-established educational research was broadly two dimensional: neuromyths and teaching principles. A modest positive relationship was identified between the factors thereby suggesting that teachers who are better able to identify neuromyths (i.e., factor one) were also better able to identify well-established, research-based teaching principles (i.e., factor two). Reinforcing the importance of overcoming barriers teachers face in accessing educational research, those who utilised more resources and took more steps to engage with educational research were better able to accurately identify well-established educational research findings (see section 7.2.3). However, that finding contradicts Levin et al (2011) who found that interventions designed to increase teachers' research engagement had little impact on their ability to identify well-established educational research findings. Notably, Levin et al (2011) admit that the interventions 'had limited success' (p. 2) and 'were not adopted in many districts' (p. 24). Perhaps for reasons such as those, others (e.g., Brown, 2017) have been more critical of the proposition that simply exposing teachers to well-established research findings will improve their awareness of them. Nelson et al (2017) fail to provide analysis of a relationship between teachers' engagement with, and ability to correctly identify, educational research findings.

This investigation was the first to utilise SDT thereby enabling comparison of teachers' ability to identify well-established educational research findings against that expected by chance. Teachers' ability to identify well-established, research-based teaching principles was little better than chance but their ability to identify neuromyths was substantially below. Using a reasonable criterion, under one-quarter of teachers would be considered 'research-informed' overall, thereby supporting Boser (2019) and Nelson et al's (2017) earlier conclusion that teachers had, 'overall, a weak conceptual understanding of current research knowledge' (p. 21). However, their findings are progressed here by illustrating that the picture is somewhat complicated because of variation in teachers' knowledge of research findings across topics.

In comparing teachers' awareness of neuromyths, there is more literature available for comparison. Howard-Jones et al (2009) and Dekker et al (2012) both concluded that teachers' neuroscience literacy is little better than the general public's. This investigation reinforces that, asserting that teachers' awareness of neuromyths are below that expected by chance. There is little reason to believe that general public performance would vary significantly from chance.

There is little literature available to compare teachers' ability to identify well-established, research-based teaching principles across teachers of different demographics as neither Levin et al (2011) nor Boser (2019) provide sufficient information. Nelson et al (2017) provide detail enabling comparison only across teachers' role seniority. They report that teachers in more senior roles were better able to identify research findings and some supporting evidence was revealed here with School Survey respondents better able to identify neuromyths than classroom teachers. However, seniority failed to play a role in identifying well-established, research-based teaching principles. Teachers' highest qualification appeared to also influence their performance as those with a PhD were better able to identify well-established, research-based teaching principles than respondents with an undergraduate degree only.

There is more literature available to enable comparison between performance of teachers with different demographics in their ability to identify neuromyths. Macdonald et al (2017) found age and level of education to be predictors whereas this investigation (see section 7.3.3) and Dekker et al (2012) report evidence to the contrary. Though Macdonald et al's (2017) investigation was based on a larger sample, their survey was distributed postally facilitating opportunity to seek assistance during completion. Here, teachers' subject specialism appeared to play a role as those of physical sciences were better able to identify neuromyths than those of mathematics and PE/ performing arts. The prevalence of neuromyths amongst teachers raises questions about the effectiveness of ITT programmes and teachers' CPD programmes. Howard-Jones et al (2009) recruited only trainee teachers whereas this investigation recruited only qualified teachers. Had either sample demonstrated strong awareness of neuromyths then we might suggest that either ITT programmes or the means teachers report using to engage with research appear to be more effective.

Collectively, the inconsistency of findings across investigations as discussed in the previous couple of paragraphs highlights that teachers are not a homogenous group, and the source(s) of heterogeneity may explain conflicting findings. To provide some examples, we might expect that teachers with a degree in psychology would be better equipped to identify neuromyths than those with a different academic background. We might also expect that, as observed, teachers with a more extensive educational background (e.g., PhD's) are more able to identify well-established educational research findings than their counterparts. While some significant differences between teacher subgroups were identified, further prevalent differences may have not been identified due to insufficient statistical power consequent to small samples within some subgroups.

Teachers almost invariably demonstrated a higher criterion for reporting well-established, research-based teaching principles to be true than neuromyths thereby suggesting that they are more likely to 'believe' in neuromyths. As discussed in section 4.3, neuromyths can often be traced back to neuroscience findings and that may explain teachers' increased buy-in to them. In other words, neuromyths do have an element of truth albeit often exaggerated and/or misapplied. Teacher demographics appeared to have little influence as the only observed significant differences was between respondents aged 61+ and those aged 21 – 30, with the former holding a higher criterion for reporting well-established, research-based teaching principles only to be true. As this is the first investigation to use SDT, we cannot compare the bias criterion demonstrated by teachers here to other samples.

High variation was observed between- and within- schools in teachers' ability to identify well-established educational research findings thereby suggesting that there is not necessarily an optimal approach to raising teachers' awareness. To explain, participating schools generally reported varied approaches to developing a research-informed culture and teachers similarly reported taking different steps to engage with educational research. Analyses failed to identify a pattern or a favourable combination of school- and teacher-level steps resulting in teachers being more research-informed. No relationship between teachers' ability to identify well-established educational research findings and: a) steps schools take in developing a research-informed culture, b) importance placed on developing said culture, or c) teachers' attitudes towards the usefulness of educational research was identified (section 7.2.4). While we are unsure about the most efficient approach to raising teachers' awareness of well-established educational research findings then it is difficult to advocate or condemn any given approach(es). That finding is particularly problematic for policy-makers and SMT for whom a key consideration will likely centre on raising teachers' awareness of well-established educational research findings.

## 8.6 RQ5: What is the relationship between: a) the research-informed teaching cultures of secondary schools, b) teachers' awareness of well-established educational research findings, c) teachers' perceptions about research usefulness, and d) student achievement?

The endeavour to identify a link between being research-informed at the school- and teacher-level was likely the most significant contribution to knowledge intended from this investigation. To reiterate correlational analyses in section 7.2.4 revealed no relationship between student achievement and: a) the extent to which a research-informed culture has been developed, b) the importance placed on developing a research-informed culture, c) teachers' attitudes towards research, d) teachers' ability to identify well-established educational research findings, e) or teachers' bias criterion. Regression analysis discussed in section 7.3.4 revealed that the best predictor of student achievement was eFSM alone. Other models illustrating a negative correlation between student achievement and: a) importance placed on developing a research-informed culture, and b) teacher criterion for reporting well-established educational research findings to be true were also identified. In line with most findings obtained from this investigation, these models pose more questions for those pushing research-informed education than they provide answers.

For policy-makers, the findings discussed in this section likely paint a concerning picture. As has been discussed, there is some reason to believe that the schools and teachers who participated in this investigation are likely more keen on driving towards research-informed education because: a) all participating schools have an ongoing relationship with EHU, and b) participating teachers agreed to participate in a study about research-informed education. As such, schools within this investigation may fare better than those nationally in the variables measured in both surveys. It may be an over-extension of these findings to suggest that they provide evidence that mechanisms implemented to drive research-informed education are not working effectively. However, the absence of a relationship will undoubtedly be of some concern to policy-makers.

## 8.7. Summary of Research Findings

To broadly summarise, this investigation failed to identify a positive relationship between the extent to which teachers and schools are research-informed and student achievement. Indeed, it seems that secondary school education in England has not yet developed in such a way that all proposed conditions for becoming research-informed are fulfilled at the same time. That conclusion is largely based on the observation that there are indeed highly research-informed teachers, but they do not necessarily work in a school that has the structures in place to develop a strong research-informed culture (e.g., research allocated time) or even places substantial importance on doing so.

To some extent, those findings contradict previous investigations which have endeavoured to identify a link between being research-informed and student achievement as, usually, marginal gains in achievement have been registered (e.g., Wiliam et al, 2004; Piasta et al, 2020; Huat-see et al, 2016; Rose et al, 2017). The noted investigations were discussed in section 3.7 and their findings should be compared against those obtained here cautiously because of their methodological issues (e.g., teacher-reports measures of student achievement). More generally, the studies mentioned above differed from this investigation as they measured the impact of implementing specific research-informed interventions on student achievement. The current investigation took a more sophisticated and holistic approach to exploring determinants of student achievement associated with research-informed education at the school- and teacher-level. Upon reflection, it should be of little surprise that research continues to struggle to identify a clear link between being research-informed and student achievement and some possible explanations will now be discussed.

To begin, research has identified almost endless determinants of student achievement; Hattie (2009), for example, identified over 250 at student (e.g., motivation), teacher (e.g., subject-specific knowledge), teaching strategies (e.g., feedback ), school (e.g., ability grouping ), curricula (e.g., career interventions), and home (e.g., parental involvement) levels. Beyond those, there are other factors such as intelligence which are not explicitly discussed by Hattie (2009) but are reportedly highly influential in determining student achievement (Watkins, Lei & Canivez, 2007).

Additional determinants of student achievement notwithstanding, readers should refer back to the complexity with which educational research influences teachers' practice as discussed throughout Chapter Four. As reiterated throughout this thesis, the consensus amongst academics favours a complex and intricate process of teachers' research utilisation (e.g., Hammersley, 2005; Cain, 2016a) which improves their practice by 'influencing the content and the process of their thinking, changing attitudes and perceptions' (Cain & Allan, 2017; p. 718). Consequently, it is conceivable that a direct relationship between being research-informed and student achievement would not be observable and improved student achievement would be observable only following a lengthy and sustained period of research engagement. There is arguably some evidence for this because, of the relevant studies discussed, Rose et al (2017) reported perhaps the most convincing impact of research-informed practice on student achievement but also the longest intervention period (two years).

A second hypothesis is that being research-informed at the teacher- and/or school-level genuinely has a negative effect on student achievement and there are several potential explanatory mechanisms. For example, excessive attention paid to becoming research-informed could result in the practice of teaching and the personal skills which contribute to it (e.g., tacit knowledge) being neglected. This proposition is made tentatively as the researcher is unaware of any evidence to support it. However, as highlighted by Cain (2018), there are a selection of researchers (e.g., Dewey, Biesta) who share the view that the possibility of educational research directly guiding teachers' practice is 'not just difficult and a long way off, but impossible in principle' (Wiliam et al, 2004; p.51). Consequently, it is plausible that pursuit of becoming research-informed is simply steering teachers away from activities which may be more effective in improving their practice (and subsequently raising student achievement).

Alternative motives for becoming research-informed should also be considered. For example, based on the regular communications from the DfE (e.g., *Educational Excellence Everywhere,* 2016), it is conceivable that teachers and SMT may feel obligated to become research-informed in hope that it will improve performance in either student grades or Ofsted inspections. Notably, Ofsted make no mention of a desire for schools to engage in, or with, educational research in their School Inspection Handbook (2019). Perhaps the closest link is a necessity for school leaders to both: 'focus on improving staff's pedagogical knowledge to enhance teaching' and 'have a clear and ambitious vision for providing high-quality, inclusive education' (p. 11). SMT would have good reason to make steps towards meeting those objectives by engaging with educational research and encouraging teachers to do the same.

### 8.8 Research Limitations

This investigation is built on the proposition that educational research has been successful in identifying a selection of well-established findings developed through robust research, evidenced consistently, and communicated to teachers (i.e., RQ1). Though a systematic literature review was conducted to identify those findings, it is unrealistic to claim that either all published practitioner texts or the entirety of supporting academic literature was subsequently accessed. Consequently, it is conceivable that other educational research findings which meet the instated criteria were overlooked. As such, the representativeness of the identified educational research findings against the whole of those in existence is unknown. With that said, the literature review was conducted in a thorough and systematic way therefore it is unlikely that multiple findings which meet the criteria would have been missed.

The criteria instated during that literature review were justified in section 6.2 and they largely favoured quantitative, comparative research. Had a more methodologically diverse range of literature been accepted, additional well-established educational research findings may have been identified and that raises some further issues. For example, it may be the case that teachers are more or less able to identify findings from research of alternative methodologies, thereby potentially indicative of either teachers' preference for, and/or ability to intellectually access particular research methodologies.

Issues surrounding generalisability of this investigations findings following recruitment of a limited sample have been discussed and will not be reiterated but developed here. In further evaluating the sampling strategy used to recruit participants, the possibility that participating schools and teachers are subgroups with a greater inclination towards research-informed education than most nationwide should be considered. Should that be the case, then the findings discussed for RQs 2-4 would likely be misleadingly positive and the internal validity of the current investigation compromised. Some reassurances can be taken as representativeness of both the school and teacher sample against those nationally was verified. However, said representativeness was determined based on the limited institutional and professional demographics available and do not necessarily relate to enthusiasm for research utilisation. A second possible issue relating to the school recruitment process centres on uncertainty about the infrastructure established within each school. As discussed on several occasions, SMT play a fundament role in developing a research-informed culture. Retrospectively, it may have been worthwhile ensuring that participating schools were not in a period of transition (e.g., change of leadership) as collecting data at that time may have created an inaccurate depiction of that school's culture.

Rationale for the pragmatic methodological approach adopted and subsequent use of a multimethod research strategy have been illustrated. However, the extent to which inferences can be made based on the 'box-ticking' strategy used to gather evidence for RQ 2 & 3 could be questioned. Culture is a difficult phenomenon to capture and, for Scott, Mannion, Davies, and Marhsall (2003), that remains true in the context of organisations. Perhaps for that reason, Scott et al (2001) argue that no consensus exists about the most appropriate approach to capturing a culture. In this investigation, a decision was made that each construct in Cain's (2018) framework would be measured primarily in a quantitative way. However, it could be suggested that said approach would be inadequate for illustrating the extent to which reported steps taken to developing a research-informed culture are conducted in a meaningful way. Similar criticisms could be made for Teacher Survey: Section One because, for example, while some teachers reported engaging with academic literature, we cannot verify how meaningful that engagement is. It would be difficult to avoid that problem in further investigation, though alternative research methods (e.g., observations) may be more informative.

There is also the possibility that participants across both the School Survey and Teacher Survey: Section One responded in ways that they perceived to be socially desirable. Here, respondents may have over-stated the extent to which they and the schools in which they work engage with educational research and take steps to develop a research-informed culture, respectively. Unfortunately, the extent to which social desirability has (or has not) played a role cannot be verified as no secondary data to support participant responses was collected.

Retrospectively, operationalisation of measuring the extent to which teachers were research-informed (i.e., RQ4) was perhaps incomplete. The current investigation gained a snapshot of teachers' awareness of well-established educational research finding, however, it makes sense that teachers with the intellectual tools to differentiate between: a) the functions of different research methods, and b) research of differing quality, would be better equipped to maintain currency with research findings. Some recent research (e.g., Nelson et al, 2017) has addressed this limitation by measuring teachers' research literacy which is important because research literacy may facilitate and therefore predict awareness of well-established educational research findings and ability to identify neuromyths.

## 8.9 Future Research

Several directions for future research have been considered; each making use of, and building upon, progress made through this investigation. The suggested directions will also: a) address the absence of a relationship between being research-informed and student achievement (see section 8.7), and/or b) the limitations of the current investigation (see section 8.8).

Given the sheer volume of potential determinants of student achievement as discussed in section 8.7, a useful starting point for future research may be to build on this investigation's findings by incorporating the teacher- and school-level variables investigated here in a larger, more sophisticated model which includes several other prominent determinants of student achievement. As discussed in section 5.7, plans were in place to use multilevel analysis in this investigation. However, a decision was made against using multilevel analysis because the univariate and multivariate analyses conducted in sections 7.2.4 and 7.3.4 quite clearly failed to illustrate meaningful interactions between the variables of interest. Failure to identify meaningful interactions is perhaps a product of the broad within- and between-school variance in data gathered from the Teacher Survey and School Survey.

Future research could investigate the hypotheses discussed in section 8.7 by using a design similar to Levin et al (2011) and Rose et al (2017); a longitudinal observational design in which student achievement, the extent to which schools have a research-informed culture, and teachers' knowledge of well-established educational research findings are assessed pre-/post- a selection of whole-staff teacher CPD interventions designed to increase research engagement. The suggested research design is not novel, however, measuring the highlighted variables in a systematic way (similar to the approach taken in this investigation) would negate the 'snapshot' limitation of this investigation discussed in section 8.8.

Alternatively, and perhaps more practically, inferences about progress made in developing research-informed education and subsequent impact on student achievement could be made based on replicating the current investigation at a later date. In doing so, concerns surrounding some schools potentially being in a current period of transition would be tackled and evidence about the impact of mechanisms discussed in section 2.4 to develop research-informed education would also be acquired.

## 8.10 Conclusion

This investigation was created largely with the intention of filling three substantial gaps in current literature each fundamental to the development of research-informed education for researchers, policy-makers, and teachers. To begin, this study is pioneering in examining the most fundamental steps that research-based knowledge takes from conception to impact. As earlier acknowledged, the way in which teachers use research-based knowledge is undoubtedly important and the decision to investigate that to arguably only a superficial level has been justified.

The second contribution to knowledge made in this investigation is the production of strong evidence that educational research is capable of developing knowledge which is useful for guiding teachers' practice through methodologically robust, well-designed research, and that knowledge is subsequently communicated to teachers in ways that are accessible. Previous research has reported identifying claims to knowledge but often without illustrating the methodological parameters in which said knowledge was created and the robustness of it. Furthermore, prior research identifying claims to knowledge have often discussed factors which would likely have little influence on teaching practice.

The final (and probably most important) contribution this investigation makes is in its attempt to identify a direct link between the extent to which schools and teachers are research-informed and student achievement. Though undoubtedly imperfect, the approach taken to identify said relationship in this investigation was methodologically stronger than the most closely related literature. Despite those efforts, the propositions put forward by Cain (2018) and Coldwell et al (2017) that evidence of a relationship between being research-informed and student achievement is thin, remain.

To provide some parting remarks, Coldwell et al (2017; p. 70) conclude by proposing that the challenge for policy-makers in developing research-informed educations is not 'the supply of, or demand for, evidence: rather it is with the level of leadership capacity and commitment to make it happen'. The findings of this investigation provide mixed support for their conclusions. Evidently, there is a (albeit thin) bank of research-based knowledge which is useful for teachers and teachers reporting a willingness to engage with research. However, evidence from this investigation reiterates previous research and further highlights that teachers are often not aware of well-established research findings and fall foul to false knowledge. For drivers of research-informed education, this problem raises major questions and it is conceivable that we may need to go beyond implementing mechanisms to increase teachers' exposure to research-based knowledge. Instead, efforts may be better focused on 'understanding the mechanisms Investigating the processes and mechanisms by which teachers become research engaged and research literate' (Nelson et al, 2017; p. 32).

Of equal immediate concern for proponents of research-informed education is the absence of a relationship between being research-informed and student achievement. As such, it seems sensible that policy-makers primary focus ought to be on identifying robust evidence of a relationship between being research-informed and student achievement. Without said evidence, the costly thrust towards research-informed education will remain based on little more than a proposition.

## References


ADÈR, H., 2008. The Main Analysis Phase. In: H. ADLER, G. MELLENBERGH, and D. HAND, eds. *Advising on Research Methods: A Consultants Companion.* Huizen, Netherlands*:* Johannes Van Kessel Publishing. pp. 357 - 384.

AILINGER, R. L., 2003. Contributions of qualitative research to evidence-based practice in nursing. *Revista latino-americana de Enfermagem* [online]. 11 (3), pp. 275 - 279. Available from: https://doi.org/10.1590/S0104-11692003000300002 (Accessed 10 March 2019)

ALLEN, R., 2013. Evidence-based Practice: Why Number-Crunching Tells Only Part of the Story. *UCL IOE London blog*. [Blog online]. 14 March. Available from: http://ioelondonblog.wordpress.com/2013/03/14/evidence-based-practice-why-number-crunching-tells-only-part-of-the-story (Accessed May 28 2018).

ANGUERA, M. T., BLANCO-VILLASEÑOR, A., LOSADA, J. L., SÁNCHEZ-ALGARRA, P. and ONWUEGBUZIE, A. 2018. Revisiting the difference between mixed methods and multimethods: Is it all in the name? *Quality & Quantity* [online]. 52 (6), pp. 2757 - 2770. Available from: https://doi.org/10.1007/s11135-018-0700-2 (Accessed 29 June 2019).

BADLEY, G. 2003. The crisis in educational research: a pragmatic approach. *European educational research journal* [online]. 2 (2), pp. 296 - 308. Available from: https://doi.org/10.2304%2Feerj.2003.2.2.7 (Accessed 10 July 2020)

BAHRICK, H.P. and HALL, L.K., 1991. Lifetime maintenance of high school mathematics content. *Journal of Experimental Psychology: General* [online]. 120 (1), pp. 20 - 33. Available from: https://doi.org/10.1037/0096-3445.120.1.20 (Accessed 10 June 2017)

BARNETT, S.M. and CECI, S. J., 2002. When and where do we apply what we learn?: A taxonomy for far transfer. *Psychological Bulletin* [online]. 128 (4), pp. 612 – 637. Available from: https://doi.org/10.1037/0033-2909.128.4.612 (Accessed 26 June 2017)

BASSEY, M., 1999. *Case study research in educational settings*. London: McGraw-Hill Education.

BELL, M., CORDINGLEY, P., ISHAM, C. and DAVIS, R., 2010. *Report of Professional Practitioner Use of Research Review: Practitioner engagement in and/or with research.* Coventry: CUREE, GTCE, LSIS & NTRP. Available from: http://www.curee.co.uk/node/2303 (Accessed 15 January 2021)

BENNETT, T., 2013. *Teacher proof: Why research in education doesn't always mean what it claims, and what you can do about it*. London: Routledge.

BEYCIOGLU, K., OZER, N. and UGURLU, C., 2010. Teachers' views on educational research. *Teaching and Teacher Education* [online]. 26 (4), pp. 1088 - 1093. Available from: http://dx.doi.org/10.1016/j.tate.2009.11.004 (Accessed 15 October 2016).

BIESTA, G., 2007. Why "what works" won't work: Evidence-based practice and the democratic deficit in educational research. *Educational Theory* [online]. 57 (1). pp. 1 - 22. Available from: http://dx.doi.org/10.1111/j.1741-5446.2006.00241.x (Accessed 25 October 2016).

BIESTA, G., 2010. Why 'What Works' Still Won't Work: From Evidence-Based Education to Value-Based Education. Studies in Philosophy and Education. 29 (5), pp 491 – 503. Available from: https://doi.org/10.1007/s11217-010-9191-x (Accessed 2 February 2018).

BIESTA, G., 2012. The future of teacher education: Evidence, competence or wisdom? *Research on Steiner Education*. 3, pp. 8 - 21.

BIESTA, G.J. and BURBULES, N., 2003. *Pragmatism and educational research*. Lanham, MD: Rowman and Littlefield.

BLACK, P. and WILIAM, D., 1998. *Inside the Black Box: Raising standards through classroom assessment*. School of Education, King's College, London.

BLOOM, K.C. and SHUELL, T.J., 1981. Effects of massed and distributed practice on the learning and retention of second-language vocabulary. *The Journal of Educational Research* [online]. *74* (4), pp. 245 - 248. Available from: https://doi.org/10.1080/00220671.1981.10885317 (Accessed 3 February 2019).

BLUNKETT, D., 2000. Influence or Irrelevance: can social science improve government? *Research Intelligence,* British Educational Research Association. 71, pp. 12 - 21.

BOLARINWA, O.A. 2015. Principles and methods of validity and reliability testing of questionnaires used in social and health science researches. *Nigerian Postgraduate Medical Journal* [online]. 22 (4), pp. 195 - 201. Available from: http://www.npmj.org/text.asp?2015/22/4/195/173959 (Accessed 1 March 2018)

BORG, S., 2009. English Language Teachers' Conceptions of Research. *Applied Linguistics* [online]. 30 (3), pp. 358 – 388. Available from: http://www.education.leeds.ac.uk/assets/files/staff/papers/Borg-AL-2009.pdf (Accessed 2 December 2016)

BOSER, U., 2019. *What Do Teachers Know About The Science of Learning? The Learning Agency* [online]. Available from: https://www.the-learning-

agency.com/insights/what-do-teachers-know-about-the-science-of-learning#
(Accessed 30 March 2020).

BOWERS, J. S. 2016. The practical and principled problems with educational neuroscience. *Psychological Review* [online]. 123 (5), pp. 600 - 612. Available from: http://doi.org/10.1037/rev0000025 (Accessed 3 May 2017)

BRADLEY, K., ROYAL, K., CUNNINGHAM, J., WEBER, J. and ELI, J., 2008. What Constitutes 'Good' Educational Research? A Consideration of Ethics, Methods, and Theory. *Mid-Western Educational Researcher* [online]. 21 (1), pp. 26 - 36. Available from:
http://www.uky.edu/~kdbrad2/EPE773R/StudentPapers/GoodEducationalResearch.pdf (Accessed 8 November 2016).

BRITISH EDUCATIONAL RESEARCH ASSOSCIATION, 2011. *Ethical Guidelines for Educational Research*. London: BERA.

BROPHY, J., 1981. Teacher praise: A functional analysis. *Review of Educational Research* [online]. 51 (1), pp. 5 – 32. Available from: https://doi.org/10.2307/1170249 (Accessed 16 June 2017)

BROWN, C., 2017. Research learning communities: How the RLC approach enables teachers to use research to improve their practice and the benefits for students that occur as a result. *Research for All* [online]. 1 (2), pp. 387 – 405. Available from: https://doi.org/10.18546/RFA.01.2.14 (Accessed 10 February 2020)

BROWN, C., DALY, A. and LIOU, Y.H., 2016. Improving trust, improving schools: Findings from a social network analysis of 43 primary schools in England. *Journal of Professional Capital and Community [online]. 1* (1), pp. 69 – 91. https://doi.org/10.1108/JPCC-09-2015-0004 (Accessed 15 August 2017).

BROWN, C. and GREANY, T., 2017. The Evidence-Informed School System in England: Where Should School Leaders Be Focusing Their Efforts? *Leadership and Policy in Schools [online]. 17 (1),* pp. 115 – 137. Available from: https://doi.org/10.1080/15700763.2016.1270330 (Accessed 30 January 2021)

BROWN, C. and GREANY, T., 2018. The evidence-informed school system in England: Where should school leaders be focusing their efforts? *Leadership and Policy in Schools* [online]. *17* (1), pp. 115 - 137. Available from: https://doi.org/10.1080/15700763.2016.1270330 (Accessed 10 Jan 2019).

BROWN, C. and ZHANG, D., 2016. Is engaging in evidence-informed practice in education rational? What accounts for discrepancies in teachers' attitudes towards evidence use and actual instances of evidence use in schools? *Cambridge Journal of Education* [online]. pp. 1 – 19. Available from: http://dx.doi.org/10.1080/0305764X.2016.1158784 (Accessed 19 October 2016)

BURKE-JOHNSON, R. and ONWUEGBUZIE, A., 2004. Mixed Methods Research: A Research Paradigm Whose Time Has Come. *Educational Researcher* [online]. 33 (7), pp. 14 - 26. Available from: http://www.jstor.org/stable/3700093 (Accessed 20 December 2018)

BUTLER, A. C., 2010. Repeated testing produces superior transfer of learning relative to repeated studying. *Journal of Experimental Psychology: Learning, Memory, and Cognition* [online]. *36* (5), pp. 1118 – 1133. Available from: https://doi.org/10.1037/a0019902 (Accessed 15 March 2017).

BUTLER, R., 1987. Task-involving and ego-involving properties of evaluation: Effects of different feedback conditions on motivational perceptions, interest, and performance. *Journal of educational psychology* [online]. 79 (4), pp. 474 - 482. Available from: https://doi.org/10.1037/0022-0663.79.4.474 (Accessed 28 October 2016)

BUTLER, R., 1988. Enhancing and undermining intrinsic motivation: The effects of task involving and ego-involving evaluation on interest and performance. *British Journal of Educational Psychology* [online]. 58, pp. 1 – 14. Available from: http://onlinelibrary.wiley.com/doi/10.1111/j.2044-8279.1988.tb00874.x (Accessed 28 October 2016)

CABINET OFFICE, 2013. *What Works Network* [online]. Available from: https://www.gov.uk/guidance/what-works-network. (Accessed 4 December 2016)

CAIN, T., 2015(a). Teachers' Engagement with Published Research: Addressing the Knowledge Problem. *Curriculum Journal* [online]. 26 (3), pp. 488 – 509. Available from: http://dx.doi.org/10.1080/09585176.2015.1020820 (Accessed 19 November 2016).

CAIN, T., 2015(b). Teachers' engagement with research texts: beyond instrumental, conceptual or strategic use, *Journal of Education for Teaching* [online]. 41 (5), pp. 478 - 492, Available from: http://dx.doi.org/10.1080/02607476.2015.1105536 (Accessed 10 October 2016).

CAIN, T., 2016a. Denial, opposition, rejection or dissent: why do teachers contest research evidence? *Research Papers in Education* [online]. pp. 1 - 15. Available from: http://dx.doi.org/10.1080/02671522.2016.1225807 (Accessed 15 October 2016).

CAIN, T., 2016(b). Research utilisation and the struggle for the teacher's soul: a narrative review. *European Journal of Teacher Education* [online]. Available from: http://dx.doi.org/10.1080/02619768.2016.1252912 (Accessed 1 December 2016).

CAIN, T., 2018. *Becoming a research-informed school: Why? What? How?* Oxfordshire: Routledge.

CAIN, T., 2019. School-University Links for Evidence-Informed Practice. *Education Sciences* [online]. 9 (2), pp. 1 – 14. Available from: https://doi.org/10.3390/educsci9020097 (Accessed 2 February 2021).

CAIN, T., BRINDLEY, S., BROWN, C., JONES, G. and RIGA, F., 2019. Bounded decision-making, teachers' reflection and organisational learning: How research can inform teachers and teaching. *British Educational Research Journal* [online]. 45 (5), pp. 1072 – 1087. Available from: https://doi.org/10.1002/berj.3551 (Accessed 4 February 2021).

CAREW, T. J. and MAGSAMEN, S. H., 2010. Neuroscience and education: An ideal partnership for producing evidence-based solutions to guide 21st century learning. *Neuron* [online]. 67, pp. 685– 688. Available from: http://dx.doi.org/10.1016/j.neuron.2010.08.028 (Accessed 10 May 2017).

CARPENTER, S.K., PASHLER, H., WIXTED, J.T. and VUL, J., 2008. The effects of tests on learning and forgetting. *Memory & Cognition [online].* 36**,** pp. 438–448. Available from: https://doi.org/10.3758/MC.36.2.438 (Accessed 26 March 2017).

CARTER, A., 2015. *Carter review of initial teacher training (ITT*). London: Crown copyright

CHATTERJI, M., 2004. Evidence on "what works": An argument for extended-term mixed-method evaluation designs. *Educational Researcher* [online]. *33* (9), pp. 3 - 13. Available from: https://www.researchgate.net/profile/Madhabi_Chatterji2/publication/250183460 (Accessed 1 July 2017).

CHEN, Z. and KLAHR, D., 1999. All Other Things Being Equal: Acquisition and Transfer of the Control of Variables Strategy. *Child Development* [online]. 70 (5), pp. 1098 - 1120. Available from: https://DOI:10.1111/1467-8624.00081 (Accessed 4 January 2017).

CHERNEY, A., POVEY, J., HEAD, B., BOREHAM, P. and FERGUSON, M., 2012. What influences the utilisation of educational research by policy-makers and practitioners? The perspectives of academic educational researchers. *International Journal of Educational Research* [online], 56, pp. 23 - 34. Available from: https://doi.org/10.1016/j.ijer.2012.08.001 (Accessed 10 January 2019).

COALITION FOR EVIDENCE-BASED POLICY (2002) *Bringing evidence-driven progress to education*. Washington, DC: Coalition for Evidence-Based Policy [online]. Available from: http://coalition4evidence.org/wp-content/uploads/2012/12/Evid-based_educ_strategy_for_ED.pdf (Accessed 2 December 2016).

COCHRAN-SMITH, M. and LYTLE, S.L., 1999. Relationships of Knowledge and Practice: Teacher Learning in Communities. *Review of Research in Education* [online]. 24, pp. 249 - 305. Available from: https://doi.org/10.3102%2F0091732X024001249 (Accessed 30 September 2017).

COHEN, L., MANION, L. and MORRISON, K., 2011. *Research methods in education.* 7th edition. London: Routledge.

COLDWELL, M., GREANY, T., HIGGINS, S., BROWN, C., MAXWELL, B., STIELL, L., WILLIS, B. and BURNS, H., 2017. *Evidence-informed teaching: an evaluation of progress in England. Research report July 2017*. Department for Education.

CONNOLLY, P., KENNAN, C. and URBANSKA, K., 2018. The trials of evidence-based practice in education: a systematic review of randomised controlled trials in education research 1980–2016. *Educational Research* [online]. 60 (3), pp. 276 - 291. Available from: https://doi.org/10.1080/00131881.2018.1493353 (Accessed 10 January 2019).

COOK, T., 2007. Randomized Experiments in Education: Assessing the Objections to Doing Them. *Economics of Innovation and New Technology* (online). 16 (5), pp. 331 - 355, Available from: http://dx.doi.org/10.1080/10438590600982335 (Accessed 1 December 2016).

COOPER, H., 1989. *Homework*. Vancouver: Longman.

COOPER, H., LINDSAY, J.J., NYE, B. and GREATHOUSE, S., 1998. Relationship among attitudes homework, amount of homework assigned and completed, and student achievement. *Journal of Educational Psychology* [online]. 90 (1), pp. 70 - 83. Available from: https://psycnet.apa.org/doi/10.1037/0022-0663.90.1.70 (Accessed 11 November 2016).

COOPER, H., ROBINSON, J.C. and PATALL, E.A., 2006. Does homework improve academic achievement? A synthesis of research, 1987–2003. *Review of educational research* [online]. *76* (1), pp. 1 - 62. Available from: https://doi.org/10.3102/00346543076001001 (Accessed 15 November 2016).

CORDINGLEY, P., 2008. Research and evidence-informed practice: Focusing on practice and practitioners. *Cambridge Journal of Education* 38 (1), pp. 37 – 52.

DAGENAIS, C., LYSENKO, L., ABRAMI, P., BERNARD, R., RAMDE, J. and JANOSZ, M., 2012. Use of research-based information by school practitioners and determinants of use: a review of empirical research. *Evidence & Policy: Journal of Research, Debate and Practice* [online]. 8 (3), pp. 285 – 309. Available from: https://doi.org/10.1332/174426412X654031 (Accessed 2 December 2016)

DANCEY, C. and REIDY, J., 2007. *Statistics Without Maths for Psychology*. 4th Edition. Essex: Pearson Education Limited

DAVIES, P. 1999. What is Evidence-Based Education? *British Journal of Educational Studies* [online]. 47 (2), pp. 108 - 121. Available from: https://doi.org/10.1111/1467-8527.00106 (Accessed 15 November 2016).

DEAN, C. B., HUBBELL, E. R., PITLER, H. and STONE, B., 2012. *Classroom instruction that works: research-based strategies for increasing student achievement*. Alexandria: ASCD

DECI, E., RYAN, R. and KOESTNER, R., 1999. A Meta-Analytic Review of Experiments Examining the Effects of Extrinsic Rewards on Intrinsic Motivation. *Psychological Bulletin* [online]. 125 (6), pp. 627 - 668. Available from: https://psycnet.apa.org/doi/10.1037/0033-2909.125.6.627 (Accessed 26 November 2016).

DEKKER, S., LEE, N., HOWARD-JONES, P. and JOLLES, J., 2012. Neuromyths in education: Prevalence and predictors of misconceptions amongst teachers. *Frontiers in Psychology* [online]. 3 (429), pp. 1 - 8. Available from: https://doi.org/10.3389/fpsyg.2012.00429 (Accessed 5 December 2016).

DEPARTMENT FOR EDUCATION, 2010. *The Importance of Teaching* [online]. London: TSO. Available from: https://www.gov.uk/government/publications/the-importanceofteaching-the-schoolswhite-paper-2010 (Accessed 12 June 2017).

DEPARTMENT FOR EDUCATION, 2014. *Department for Education* [online[. Retrieved from: https://www.gov.uk/government/organisations/department-for-education. (Accessed 11 May 2017).

DEPARTMENT FOR EDUCATION, 2015. *Final report of the Commission on Assessment without Levels* [online]. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/483058/Commission_on_Assessment_Without_Levels_-_report.pdf (Accessed 20 June 2019)

DEPARTMENT FOR EDUCATION, 2016. *Educational Excellence Everywhere* [online]. London: TSO. Available from: https://www.gov.uk/government/publications/educational-excellence-everywhere (Accessed 12 June 2017).

DEPARTMENT FOR EDUCATION, 2020. *Secondary accountability measures (including Progress 8 and Attainment 8)* [online]. London: TSO. Available from: https://www.gov.uk/government/publications/progress-8-school-performance-measure (Accessed 15 March 2020)

DEPARTMENT FOR EDUCATION AND EMPLOYMENT, 2001. *Schools: Building on Success* [online]. London: TSO. Available from: https://www.gov.uk/government/publications/schools-building-on-success-raising-standards-promoting-diversity-achieving-results (Accessed 22 March 2019)

DEWEY, J., 1929. *The Sources of a Science of Education*. New York: Liveright.

DIDAU, D., 2015. What if everything you knew about education was wrong? Carmarthen, Wales: Crown House Publishing

DIMMOCK, C., 2016. Conceptualising the research–practice–professional development nexus: mobilising schools as 'research-engaged' professional learning communities. *Professional Development in Education* [online]. 42 (1), pp. 36 - 53. Available from: https://doi.org/10.1080/19415257.2014.963884 (Accessed 10 September 2017)

DONKER, A. S., DE BOER, H., KOSTONS, D., VAN EWIJK, C.D. and VAN DER WERF, M.P., 2014. Effectiveness of learning strategy instruction on academic performance: A meta-analysis. *Educational Research Review* [online]. *11*, pp. 1 - 26. Available from: https://doi.org/10.1016/j.edurev.2013.11.002 (Accessed 16 July 2017).

DONMOYER. R., 1996. The concept of a knowledge base. In F. MURRAY, ed. *The teacher educator's handbook.* San Francisco, Jossey-Bass. pp. 92 - 119.

DONOVAN, J.J. and RADOSEVICH, D.J., 1999. A meta-analytic review of the distribution of practice effect: Now you see it, now you don't. *Journal of Applied Psychology* [online]. 84 (5), p. 795 - 805. Available from: https://psycnet.apa.org/doi/10.1037/0021-9010.84.5.795 (Accessed 10 Febuary 2019).

DRACUP, T., (2014) *The Politics of Setting*. Gifted Phoenix. [Blog online]. 12 November. Available from: https://giftedphoenix.wordpress.com/2014/11/12/the-politics-of-setting/ (Accessed 6 March 2017).

DÜNDAR, S. and GÜNDÜZ, N., 2016. Misconceptions regarding the brain: the neuromyths of preservice teachers. *Mind, Brain, and Education* [online], 10 (4), pp. 212 - 232. Available from: https://doi.org/10.1111/mbe.12119 (Accessed 1 November 2017).

EDUCATION DEVELOPMENT TRUST. 2016. *What we do* [online]. Available from: http://www.educationdevelopmenttrust.com/en-GB/what-matters-to-us/who-we-are (Accessed 11 December 2016).

EDUCATION ENDOWMENT FOUNDATION. 2016. *About us* [online]. Available from: https://educationendowmentfoundation.org.uk/ (Accessed 10 November 2016).

EDUCATION ENDOWMENT FOUNDATION. 2016. *Research into Practice - Evidence-informed CPD in Rochdale* [online]. Available from: https://educationendowmentfoundation.org.uk/ (Accessed 4 January 2017).

EDUCATION ENDOWMENT FOUNDATION, 2018. *Sutton Trust - Education Endowment Foundation Teaching and Learning Toolkit* [online]. London: Education Endowment Foundation. Available from: https://educationendowmentfoundation.org.uk/evidence-summaries/teaching-learning-toolkit (Accessed 20 June 2020).

ELLIOTT, J., 2001. Making Evidence-based Practice Educational. *British Educational Research Journal* (online). 27 (5), pp. 555 - 575. Available from: https://doi.org/10.1080/01411920120095735 (Accessed 4 January 2017).

ELO, S. and KYNGAS, H., 2007. The qualitative content analysis process. *Journal of Advanced Nursing* [online]. 62, pp. 107 - 115. Available from: https://doi.10.1111/j.1365-2648.2007.04569.x (Accessed 28 December 2016).

ETIKAN, I., MUSA, S. and ALKASSIM, R., 2016. Comparison of Convenience Sampling and Purposive Sampling, *American Journal of Theoretical and Applied Statistics* [online]. 5 (1), pp. 1 - 4. Available from: https://doi.org/10.11648/j.ajtas.20160501.11 (Accessed 29 November 2018)

EVERTON, T., GALTON, M., and PELL, T., 2002. Educational research and the teacher. *Research Papers in Education* [online]. 17 (4), pp. 373 - 401. Available from: http://dx.doi.org/10.1080/0267152022000031388 (Accessed 28 November 2016).

EYSENCK, H.J., 1994. Systematic Reviews: Meta-analysis and its problems. *British Medical Journal* [online]. 309, pp. 789 – 792. Available from: https://doi.org/10.1136/bmj.309.6957.789 (Accessed 7 November 2016).

FISCHER, T.A. and TARVER, S.G., 1997. Meta-analysis of studies of mathematics curricula designed around big ideas. *Effective School Practices* [online], 16, pp. 71–79. Available from: https://www.nifdi.org/research/esp-archive/volume-16/374-effective-school-practices-vol-16-no-1-2-fall-1996-winter-1997.html (Accessed 10 Jan 2019)

FLYNN, N., POWELL, D., STAINTHORP, R. and STUART, M., 2021. Training teachers for phonics and early reading: Developing research-informed practice. *Journal of Research in Reading* [online], pp. 1 – 18. Available from: https://doi.org/10.1111/1467-9817.12336 (Accessed 2 February 2021)

FUSON, K.C., 2009. Avoiding misinterpretations of Piaget and Vygotsky: Mathematical teaching without learning, learning without teaching, or helpful learning-path teaching? *Cognitive Development* [online]. 24 (4), pp. 343 - 361.

Available from: https://doi-org.edgehill.idm.oclc.org/10.1016/j.cogdev.2009.09.009 (Accessed 23 June 2020)

GALL, M.D., BORG, W.R. and GALL, J.P., 1996. Educational research: An introduction. 6th edition. White Plains, NY: Longman.

GARDNER, W.E., 1989. Preface. In M. C. REYNOLDS, ed. *Knowledge base for the beginning teacher*. New York, Pergamon Press. pp. ix-xii.

GEAKE, J., 2008. Neuromythologies in education. *Educational Research* [online]. 50 (2), pp. 123 - 133. Available from: https://doi.org/10.1080/00131880802082518 (Accessed 8 June 2018).

GIANGRECO, M. and TAYLOR, S., 2003. "Scientifically Based Research" and Qualitative Inquiry. *Research & Practice for Persons with Severe Disabilities* [online]. 28 (3), pp. 133 - 137. Available from: https://doi.org/10.2511%2Frpsd.28.3.133 (Accessed 3 April 2018).

GIBB, N., 2015. *The importance of the teaching profession* [online]. Keynote speech at ResearchED Conference, 5 September. Available online at: https://www.gov.uk/government/speeches/nick-gibb-the-importance-of-the-teaching-profession (Accessed 18 March 2018).

GLASER, C. and BURNSTEIN, J.C., 2007. Improving Fourth-Grade Students' Composition Skills: Effects of Strategy Instruction and Self-Regulation Procedures. *Journal of Educational Psychology* [online]. 99 (2), pp. 297 - 310. Available from: https://doi.org/10.1037/0022-0663.99.2.297 (Accessed 20 January 2019).

GODFREY, D., 2016. *Exploring Cultures of Research Engagement at Eight English Secondary Schools.* Unpublished Thesis (PhD). UCL Institute of Education.

GODFREY, D., 2016. Leadership of schools as research-led organisations in the English educational environment: Cultivating a research-engaged school culture. *Educational Management Administration & Leadership* [online]. 44 (2), pp. 301 - 321. Available from: https://doi.org/10.1177%2F1741143213508294 (Accessed 10 March 2017)

GOLDACRE, B., 2013. *Building Evidence into Education* [online]. London: DfE. Available from: https://www.gov.uk/government/news/building-evidence-into-education (Accessed 5 December 2016)

GOODFELLOW, J., 2003. Practical wisdom in professional practice: The person in the process. *Contemporary Issues in Early Childhood* [online[. 4 (1), pp. 48 - 63. Available from: https://doi.org/10.2304/ciec.2003.4.1.6 (Accessed 10 June 2020).

GORE, J.M. and GITLIN, A.D., 2004. [RE] Visioning the Academic–Teacher Divide: Power and Knowledge in the Educational Community. *Teachers and Teaching* [online]. 10 (1), pp. 35 – 58. Available from: https://doi.org/10.1080/1354060032000170918 (Accessed 20 May 2017).

GOSWAMI, U., 2008. Principles of learning, implications for teaching: A cognitive neuroscience perspective. *Journal of Philosophy of Education* [online]. 42 pp. 381 – 399. Available from: http://dx.doi.org/10.1111/j.1467-9752.2008.00639.x (Accessed 10 July 2017).

GOUGH, D., TRIPENY, J., KENNY, C. and BUK-BERGE, E., 2011. *Evidence informed policymaking in education in Europe* [online]. EIPPEE final project report summary, Available from: www.eipee.eu/LinkClick.aspx?fileticket=W6vkqDjbiI%3d&tabid=2510&language=en-GB (Accessed 29 November 2016)

GOUGH, D., 2013. Knowledge Mobilisation in Education in England. In, B. Levin, J. Qi, H. Edelstein, and J. Sohn, eds., 2013. *The Impact of Research in Education: An International Perspective*. Bristol: The Policy Press. pp. 124 - 169.

GOV.UK., 2013. *Newly Qualified Teachers: Annual Survey* [online]. Available from: https://www.gov.uk/government/collections/newly-qualified-teachers-annual-survey (Accessed 28 October 2016)

GREANY, T. 2014. *Are we nearly there yet? Progress, issues and possible next steps for a self-improving school system*. London: IOE Press.

GREENHALGH, T. and WORRALL, J.G., 1997. From EBM to CSM: the evolution of context-sensitive medicine. *Journal of Evaluation in Clinical Practice* [online]. 3 (2), pp. 105 – 108. Available from: https://doi.org/10.1046/j.1365-2753.1997.00096.x (Accessed 15 November 2016).

GREENHALGH, T., HOWICK, J. and MASKREY, N., 2014. Evidence based medicine: A movement in crisis? *BMJ* [online]. 348, pp. 27 - 35. Available from: https://doi.org/10.1136/bmj.g3725 (Accessed 18 June 2018)

GRODNER, A. and RUPP, N., 2013. The Role of Homework in Student Learning Outcomes: Evidence from a Field Experiment. *Research in Economic Education* (online). 44 (2), pp. 93 - 109. Available from: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1892173 (Accessed 27 October 2016).

GU, Q., REA, S., HILL, R., SMETHEM, L. and DUNFORD, J., 2014. *Teaching schools evaluation: Emerging issues from the early development of case study teaching school alliances.* London: National College for Teaching & Leadership. Available from:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/505517/RR332_-_Teaching_schools_Evaluation.pdf (Accessed 27 November 2017).

GUBA, E. G. and LINCOLN, Y. S., 1994. *Competing paradigms in qualitative research.* In N. K. DENZIN and Y. S. LINCOLN, eds. *Handbook of qualitative research*. Sage, London. pp. 105 – 117.

HAIRON, S. and GOH, J., 2015. Pursuing the elusive construct of distributed leadership: Is the search over? *Educational Management Administration & Leadership* [online]. 43 (5), pp. 693–718. Available from: https://doi.org/10.1177/1741143214535745 (Accessed 31 January 2021)

HALL, J.N., 2013. Pragmatism, evidence, and mixed methods evaluation. *New Directions for Evaluation* [online]. 138, pp. 15 – 26. Available from: https://doi.org/10.1002/ev.20054 (Accessed 30 January 2017).

HALLER, E.P., CHILD, D.A. and WALBERG, H.J., 1988. Can Comprehension Be Taught?: A Quantitative Synthesis of "Metacognitive" Studies. *Educational Researcher* [online]. 17 (9), pp. 5 – 8. Available from: https://doi.org/10.3102/0013189X017009005 (Accessed 1 October 2018).

HAMMERSLEY, M., 1997. Educational research and a response to David Hargreaves, *British Educational Research Journal* [online]. 23 (2), pp. 141 – 161. Available from: https://doi.org/10.1080/0141192970230203 (Accessed 16 November 2016)

HAMMERSLEY, M., 2005. The Myth of Research-based Practice: The Critical Case of Educational Inquiry. *International Journal of Social Research Methodology* [online]. 8 (4), pp. 317 - 330. Available from: http://dx.doi.org/doi:10.1080/1364557042000232844 (Accessed 5 November 2016).

HANCOCK, D., 2002. Influencing graduate students' classroom achievement, homework habits and motivation to learn with verbal praise. *Educational Research* [online]. 44 (1), pp. 83 - 95. Available from: https://doi.org/10.1080/00131880110107379 (Accessed 14 June 2017).

HANLEY, P., CAMBERS, B. and HASLAM, J., 2016. Reassessing RCTs as the 'Gold Standard': Synergy not Separatism in Evaluation Designs. *International Journal of Research & Method in Education* (online). 39 (3). pp. 287 – 298. Available from: https://doi.org/10.1080/1743727X.2016.1138457 (Accessed 23 November 2016).

HANDSCOMB, G. and MACBEATH, J., 2003. *The research engaged school*. Chelmsford, UK: Essex County Council Forum for Learning and Research Enquiry.

HARGREAVES, D.H., 1996. Teaching as a Research-Based Profession: Possibilities and Prospects. *Paper Presented at the Teacher Training Agency Annual Lecture* [online]. 7-9 April. Available from: http://www.nesse.fr/nesse/activities/research-mapping/research-policy-andpractice/bibliography/hargreaves.1339 (Accessed 15 November 2016).

HARRIS, A., 2008. *Distributed Leadership: Developing Tomorrow's Leaders*. London: Routledge.

HATTIE, J., 2009. *Visible Learning: A synthesis of over 800 meta-analysis relating to achievement*. Oxon: Routledge.

HATTIE, J., 2012. *Visible Learning for Teachers: Maximising Impact On Learning*. London: Routledge.

HIGHER EDUCATION FUNDING COUNCIL, 2011. *Assessment framework and guidance on submissions.* Bristol: HEFCE.

HEMPENSTALL, K., 2006. What does evidence-based practice in education mean? *Australian Journal of Learning Disabilities* (online). 11 (2), pp. 83 - 92. Available from: http://dx.doi.org/10.1080/19404150609546811 (Accessed 15 November 2016).

HEMSLEY-BROWN, J. and SHARP, C., 2003. The use of research to improve professional practice: A systematic review of the literature. *Oxford Review of Education* [online]. 29 (4), pp. 449 - 471. Available from: https://doi.org/10.1080/0305498032000153025 (Accessed 10 September 2018).

HENDERLONG, J. and LEPPER, M.R., 2002. The effects of praise on children's intrinsic motivation: A review and synthesis. *Psychological Bulletin* [online]. 128 (5), pp. 774 – 795. Available from: https://doi.org/10.1037/0033-2909.128.5.774 (Accessed 25 March 2019).

HIGGINS, S., HALL, E., BAUMFIELD, V. and MOSELEY, D., 2005. *A meta-analysis of the impact of the implementation of thinking skills approaches on pupils* [online]. Project Report. EPPI-Centre, Social Science Research Unit, Institute of Education, London. Available from: http://dro.dur.ac.uk/1890/ (Accessed 13 June 2018).

HILLAGE, J., PEARSON, R., ANDERSON, A. and TAMKIN, P., 1998. *Excellence in research on schools* [online]. London: Department for Education and Employment. Available from: http://dera.ioe.ac.uk/9856/1/RR74.pdf (Accessed 10 December 2016).

HODKINSON, P. and SMITH, J., 2004. The Relationship between Research, Policy, and Practice. In: G. THOMAS and R. PRING, eds. *Evidence-Based Practice in Education*. Berkshire: Open University Press. pp. 150 - 164.

HOWARD-JONES, P.A., FRANEY, L., MASHMOUSHI, R. and LIAO, Y., 2009. The neuroscience literacy of trainee teachers. *British Educational Research Association Annual Conference*, 2-5 September 2009. Available from: http://www.leeds.ac.uk/educol/documents/185140.pdf (Accessed 20 November 2016).

HUAT SEE, B., GORARD, S. and SIDDIQUI, N., 2016. Teachers' use of research evidence in practice: a pilot study of feedback to enhance learning. *Educational Research* (online). 58 (1), pp. 56 - 72. Available from: http://dx.doi.org/10.1080/00131881.2015.1117798 (Accessed 5 December 2016).

HULPIA, H., DEVOS, G. and VAN KEER, H., 2011. The Relation Between School Leadership From a Distributed Perspective and Teachers' Organizational Commitment: Examining the Source of the Leadership Function. *Educational Administration Quarterly* [online]. 47 (5), pp. 728 – 771. Available from: https://doi-org.edgehill.idm.oclc.org/10.1177%2F0013161X11402065 (Accessed 1 February 2021)

HUNTER, A. D. and BREWER, J., 2003. Multimethod research in sociology. In A. TASHAKKORI and C. TEDDLIE, eds. *Handbook of Mixed Methods in Social & Behavioral Research*. SAGE: London. pp. 577 – 594.

HUSBANDS, C. and PEARCE, J., 2012. *What makes great pedagogy? Nine claims from research*. Nottingham, National College for School Leadership.

ILIE, S., SUTHERLAND, A. and VIGNOLES, A., 2017, Revisiting free school meal eligibility as a proxy for pupil socio-economic deprivation. *BERJ* [online], 43. pp. 253 - 274. Available from: https://doi.org/10.1002/berj.3260 (Accessed 10 April 2017).

ILLERIS, K., 2007. *How We Learn.* London: Routledge

ION, G., MARIN, E. and PROTEASA, C., 2019. How does the context of research influence the use of educational research in policy-making and ractice?. *Educational Research for Policy & Practice* [online]. 18, pp. 119 – 139. Available from: https://doi.org/10.1007/s10671-018-9236-4 (Accessed 10 June 2020).

ION, G. and IUCU, R., 2014. Professionals' Perceptions about the Use of Research in Educational Practice. *European Journal of Higher Education* [online]. 4 (4), pp. 334 – 347. Available from: https://doi.org/10.1080/21568235.2014.899154 (Accessed 3 December 2016)

IRESON, J., HALLAM, S. and HURLEY, C., 2005. What are the effects of ability grouping on GCSE attainment? *BERJ* [online]. 31 (4), pp. 443 - 458, Available from: https://doi.org/10.1080/01411920500148663 (Accessed 13 March 2017).

JOHNSON, D.W., JOHNSON, R.T. and STANNE, M.B., 2000. Cooperative Learning Methods: A Meta-Analysis. Available from: http://www.cooperation.org/pages/cl-methods.html (Accessed 6 June 2017).

JOHNSTON, R. S. and WATSON, J., 2005. *The effects of synthetic phonics teaching on reading and spelling attainment, a seven-year longitudinal study*. Edinburgh, Scotland: Scottish Executive Education Department. Available from: http://www.scotland.gov.uk/library5/education/sptrs-00.asp (Accessed 25 September 2017).

KALOLO, J., 2015. The Drive towards Application of Pragmatic Perspective in Educational Research: Opportunities and Challenges. *Journal of Studies in Education* [online]. 5, pp. 150 - 171. Available from: http://dx.doi.org/10.5296/jse.v5i1.7145 (Accessed 27 May 2017).

KARPICKE, J. and ROEDIGER, H., 2008. The Critical Importance of Retrieval for Learning. *Science*. 319 (5865), pp. 966 - 968.

KATSIPATAKI, M. and HIGGINS, S., 2016. What Works or What's Worked? Evidence from Education in the United Kingdom. *Social and Behavioural Sciences* [online]. 217, pp. 903 – 909. Available from: https://doi.org/10.1016/j.sbspro.2016.02.030 (Accessed 7 November 2016).

KELLY, J., SADEGHIEH, T. and ADELI, K., 2014. Peer Review in Scientific Publications: Benefits, Critiques, & A Survival Guide. *EJIFCC* [online]. 25 (3), pp. 227–243. Available from: https://pubmed.ncbi.nlm.nih.gov/27683470/ (Accessed 10 July 2020).

KINCHELOE, J. and TOBIN, K., 2009. The Much Exaggerated Death of Positivism. *Cultural Studies of Science Education* [online]. 4 (3), pp. 513 - 528. Available from: https://eric.ed.gov/?id=EJ850264 (Accessed 2 March 2018).

KLUGER, A. and DENISI, A., 1996. The effects of feedback interventions on performance: A historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychological Bulletin* [online]. 119 (2), pp. 254 - 284. Available from: http://dx.doi.org.edgehill.idm.oclc.org/10.1037/0033-2909.119.2.254 (Accessed 22 November 2018)

KOBAYASHI, K., 2006. Combined Effects of Note-Taking/-Reviewing on Learning and the Enhancement through Interventions: A meta-analytic review. *Educational Psychology* [online]. 26 (3), pp. 459 - 477. Available from: https://doi.org/10.1080/01443410500342070 (Accessed 22 November 2017).

KRATKA, J., 2015. Tacit knowledge in stories of expert teachers. *Procedia-Social and Behavioral Sciences* [online]. 171, pp. 837 - 846. Available from: https://doi.org/10.1016/j.sbspro.2015.01.199 (Accessed 14 May 2017).

KYNDT, E., RAES, E., LISMONT, B., TIMMERS, F., DOCHY, F. and CASCALLAR, E., 2013. A meta-analysis of the effects of face-to-face cooperative learning. Do recent studies falsify or verify earlier findings? *Educational Research Review* [online], 10, pp. 133 - 149. Available from: https://doi.org/10.1016/j.edurev.2013.02.002 (Accessed 18 October 2016)

KORNELL, N., HAYS, M.J. and BJORK, R.A., 2009. Unsuccessful retrieval attempts enhance subsequent learning. *Journal of Experimental Psychology: Learning, Memory, and Cognition* [online]. 35 (4), pp. 989 - 998. Available from: https://doi:10.1037/a0015729 (Accessed 10 September 2017).

KOSE, S., SAHIN, A., ERGUN, A. and GEZER, K., 2010. The effects of cooperative learning experience on eighth grade students' achievement and attitude toward science. *Education*. 131 (1), pp. 169 – 180.

KULIK, C.L. and KULIK, J.A., 1982. Effects of ability grouping on secondary school students: A meta-analysis of evaluation findings. *American educational research journal* [online]. 19 (3), pp. 415 - 428. Available from: https://doi.org/10.3102/00028312019003415 (Accessed 24 January 2017).

KULIK, J.A. and KULIK, C.L., 1992. Meta-analytic findings on grouping programs. *Gifted child quarterly* [online]. 36 (2), pp. 73 - 77. Available from: https://doi.org/10.1177/001698629203600204 (Accessed 10 January 2017).

LEE, T.D. and GENOVESE, E.D., 1988. Distribution of Practice in Motor Skill Acquisition: Learning and Performance Effects Reconsidered. *Research Quarterly for Exercise and Sport* [online]. 59 (4), pp. 277 - 287. Available from: https://DOI10.1080/02701367.1988.10609373 (Accessed 20 March 2019)

LEINHARDT, G., 1990. Capturing Craft Knowledge in Teaching. *Educational Researcher* [online]. 19 (2), pp. 18 - 25. Available from: https://doi.org/10.3102%2F0013189X019002018 (Accessed 3 April 2019).

LEVENTHAL, H. and FRIEDMAN, M. A., 2004. Does establishing fidelity of treatment help in understanding treatment efficacy? Comment on Bellg et al. (2004). *Education and Treatment of Children,* 30 (4), pp. 121 - 134

LEVIN, B., SA, C., COOPER, A. and MASCARENHAS, S., 2009. Research use and its impact in secondary schools, *CEA/OISE Research Project Final Report* [online]. Available from: http://www.oise.utoronto.ca/rspe/UserFiles/File/CEA_Research_Use_in_SS_Final_Report.pdf (Accessed 4 January 2017).

LEVIN, B., COOPER, A., ARJOMAND, S. and THOMPSON, K., 2011. Can Simple Interventions Increase Research Use in Secondary Schools? *Canadian Journal of*

*Educational Administration and Policy* (online). 126, pp. 1 - 29. Available from: http://files.eric.ed.gov/fulltext/EJ955449.pdf (Accessed 1 November 2016)

LIU, P., 2020. Motivating teachers' commitment to change through distributed leadership in Chinese urban primary schools. *International journal of educational management* [online]. 34 (7), pp. 1171 – 1183. Available from: https://doi.org/10.1108/IJEM-12-2019-0431 (Accessed 31 January 2021)

LUMBY, J., 2013. Distributed Leadership: The Uses and Abuses of Power. *Educational Management Administration & Leadership* [online]. 41 (5), pp. 581 – 597. Available from: https://doi-org.edgehill.idm.oclc.org/10.1177%2F1741143213489288 (Accessed 1 February 2021).

LYSENKO, L., ABRAMI, P., BERNARD, R., DAGENAIS, C. and JANOSZ, M., 2014. Educational Research in Educational Practice: Predictors of Use. *Canadian Journal of Education* [online]. 37 (2), pp. 1 - 26. Available from: http://www.cje-rce.ca/index.php/cje-rce/article/viewFile/1477/1691 (Accessed 18 October 2016)

MACDONALD, K., GERMINE, L., ANDERSON, A., CHRISTODOULOU, J. and MCGRATH, L., 2017. Dispelling the myth: training in education or neuroscience decreases but does not eliminate beliefs in neuromyths. *Frontiers in psychology* [online]. 8 , pp. 1 - 16. Available from: https://doi.org/10.3389/fpsyg.2017.01314 (Accessed 10 December 2017).

MAGGS, A. and WHITE, R., 1982. The educational psychologist: Facing a new era. *Psychology in the Schools* [online]. 19, pp. 129 - 134. Available from: https://doi.org/10.1002/1520-6807(19820108)19:1%3C129::AID-PITS2310190123%3E3.0.CO;2-B (Accessed 15 November 2016)

MALIN, J.R. and BROWN, C., 2020. Joining worlds: Knowledge mobilization and evidence-informed practice. In J. R. MALIN and C. BROWN, eds. *The role of knowledge brokers in education: Connecting the dots between research and practice.* New York: Routledge. pp. 1 - 12.

MARLAND, M., 2002. *The Craft of the Classroom: A Survival Guide*. New Jersey, USA: Heinemann Educational.

MARTIN, A.J. and ELLIOT, A.J., 2016. The role of personal best (PB) goal setting in students' academic achievement gains. *Learning and Individual Differences* [online]. 45, pp. 222 - 227. Available from: https://doi.org/10.1016/j.lindif.2015.12.014 (Accessed 28 June 2017)

MARZANO, R.J., PICKERING, D. and POLLOCK, J.E., 2001. *Classroom instruction that works: research-based strategies for increasing student achievement*. Alexandria, Va: ASCD.

MAVLETOVA, A. and COUPER, M. P., 2015. A Meta-Analysis of Breakoff Rates in Mobile Web Surveys. In: D. TONINELLI, R. PINTER, and P. DE PEDRAZA, eds. *Mobile Research Methods: Opportunities and Challenges of Mobile Research Methodologies*. pp. 81 – 98. London: Ubiquity Press. Available from: http://dx.doi.org/10.5334/bar.f (Accessed 25 January 2018).

MCALEAVY, T., 2016. *Teaching as a research-engaged profession: problems and possibilities*. Berkshire: Education Development Trust.

MCINTYRE, D., 2006. Bridging the gap between research and practice. *Cambridge Journal of Education* [online]. 35 (3), pp. 357 - 385. Available from: http://dx.doi.org/10.1080/03057640500319065 (Accessed 17 December 2016)

MCMILLAN, H., 2012. *Educational Research: Fundamentals for the Consumer*. London: Pearson.

MCMILLIN, S., 2012. Proposing a Test for Policy-based Evidence Making: A Content Analysis of the Don't Ask, Don't Tell Review. *Journal of Policy Practice* [online]. 11 (4), pp. 255 – 272. Available from: https://doi.org/10.1080/15588742.2012.713800 (Accessed 5 December 2016)

MCMILLAN, J. and SCHUMACHER, S. 2014. Re*search in Education: Evidence-Based Inquiry.* 7th Edition. Essex: Pearson Education Limited

MCNICOL, D., 1972. *A Primer for Signal Detection Theory.* Norwich: Page Bros Ltd.

MELLENBERGH, G., 2008. Tests and Questionnaires: Construction & Administration. In: H. ADLER, G. MELLENBERGH, and D. HAND, eds. *Advising on Research Methods: A Consultants Companion.* Huizen, Netherlands*:* Johannes Van Kessel Publishing. pp. 183 - 211.

MEYER, G. J., FINN, E., EYDE, L. D., KAY, G., MORELAND, L., DIES, R., EISMAN, E. J., KUBISZYN, T. W. and REED, G. M., 2001. Psychological testing and psychological assessment: A review of evidence and issues. *American Psychologist* [online]. 56 (2), pp. 128 – 165. Available from: https://doi.org/10.1037/0003-066X.56.2.128 (Accessed 20 September 2019).

MICHALSKY, T., MEVARECH, Z. and HAIBI, L., 2009. Elementary School Children Reading Scientific Texts: Effects of Metacognitive Instruction. *The Journal of Educational Research* [online], 102 (5), pp. 363 - 376. Available from: https://doi10.3200/JOER.102.5.363-376 (Accessed 24 January 2018).

MORGAN, D. L., 2014. Pragmatism as a paradigm for social research. *Qualitative inquiry* [online]. 20 (8), pp. 1045 - 1053. Available from: https://doi.org/10.1177%2F1077800413513733 (Accessed 10 June 2018)

MOSTELLER, F., LIGHT, R. and SACHS, J., 1996. Sustained inquiry in education: Lessons from skill grouping and class size. *Harvard Educational Review* [online]. 66 (4), pp. 797 - 843. Available from: https://doi.org/10.17763/haer.66.4.36m328762x21610x (Accessed 27 October 2017).

NATIONAL AUDIT OFFICE, 2015. *Funding for disadvantaged pupils.* London: National Audit Office

NCTSL. 2008. *Everyone a leader: Identifying the core principles and practices that enable everyone to be a leader and play their part in distributed leadership* [online]. Available from: (Accessed 1 February 2021)

NCTSL. 2014. *National Teaching Schools* [online]. Available from: http://www.education.gov.uk/nationalcollege/index/supportforschools/teachingschools.htm. (accessed 31 January 2021).

NELSON, J. and O'BEIRNE, C., 2014. *Using Evidence in the Classroom: What Works and Why?* Slough: NFER.

NELSON, J., MEHTA, P., SHARPLES, J. and DAVEY, C., 2017. *Measuring Teachers' Research Engagement: Findings from a pilot study.* Education Endowment Foundation. Available at: https://educationendowmentfoundation.org.uk/public/files/Evaluation/Research_Use/NFER_Research_Use_pilot_report_-_March_2017_for_publication.pdf (Accessed 29 May 2017).

NISBET, J., 2005. What is educational research? Changing perspectives through the 20th century. *Research Papers in Education* [online]. 20, pp. 25 – 44. Available from: http://eric.ed.gov/?id=EJ694994 (Accessed 15 November 2016)

NUNNALLY, J.C., 1978. *Psychometric theory*. 2nd Edition. New York: McGraw-Hill.

NUTLEY, S. M., WALTER, I., and DAVIES, H.T., 2007. *Using evidence: How research can inform public services.* Bristol: Policy Press.

NYE, C., KONSTANTOPOULOS, S. and HEDGES, L.V., 2004. How Large Are Teacher Effects? *Educational Evaluation and Policy Analysis* [online]. 26 (3), pp. 237 - 257. Available from: http://epa.sagepub.com/content/26/3/237.short?rss=1&ssource=mfc (Accessed 22 November 2016)

OAKLEY, A., GOUGH, D., OLIVER, S. and THOMAS, J., 2005. The politics of evidence and methodology: lessons from the EPPI-Centre. *Evidence & Policy: A Journal of Research, Debate and Practice.* 1 (1), pp. 5 - 32.

OANCEA, A., 2005. Criticisms of educational research: key topics and levels of analysis. *British Educational Research Journal* [online]. 31, pp. 157 - 183. Available from: http://onlinelibrary.wiley.com/doi/10.1080/0141192052000340198/ (Accessed 3 December 2016)

OFFICE FOR STANDARDS IN EDUCATION, 2019. *Education inspection framework*. HMI 190015. London: Ofsted publications.

OLSON, D. 2004. The triumph of hope over experience in the search for “what works”: A response to Slavin. *Educational Researcher* [online]. 33 (1), pp. 24 – 26. Available from: http://edr.sagepub.com/content/33/1/24 (Accessed 4 December 2016)

ONWUEGBUZIE, A.J., 2002. Positivists, post-positivists, post-structuralists, and post-modernists: Why can't we all get along? Towards a framework for unifying research paradigms. *Education*. 122 (3), pp. 518 - 530.

PAMPAKA, M., WILLIAMS, J. and HOMER, M., 2016. Is the educational ‘what works’ agenda working? Critical methodological developments. *International Journal of Research & Method in Education* [online]. 39 (3), pp. 231 - 236. Available from: http://dx.doi.org/10.1080/1743727X.2016.1170476 (Accessed 5 November 2016)

PARIS, S.G., CROSS, D.R. and LIPSON, M.Y., 1984. Informed strategies for learning: A program to improve children's reading awareness and comprehension. *Journal of Educational Psychology* [online]. 76, pp. 1239 - 1252. Available from: https://doi:10.1037/0022-0663.76.6.1239 (Accessed 15 May 2018).

PASHLER, H., MCDANIEL, M., ROHRER, D. and BJORK, R., 2008. Learning styles: concepts and evidence. *Psychological science in the public interest* [online]. 9 (3), pp. 105 – 119. Available from: https://doi.org/10.1111%2Fj.1539-6053.2009.01038.x (Accessed 15 October 2018).

PASHLER, H., ROHRER, D., CEPEDA, N.J. and CARPENTER, S.K., 2007. Enhancing learning and retarding forgetting: Choices and consequences. *Psychonomic Bulletin & Review* [online]. 14 (2), pp. 187 - 193. Available from: http://doi:10.3758/BF03194050 (Accessed 30 April 2018)

PAWSON, R., 2006. *Evidence-based policy: A realist perspective.* London: Sage.

PHAN, H.P., 2010. Students’ academic performance and various cognitive processes of learning: An integrative framework and empirical analysis. *Educational Psychology* [online], *30* (3), pp. 297 - 322. Available from: https://doi.org/10.1080/01443410903573297 (Accessed 26 Aug 2018).

PIASTA, S.B., PARK, S., FARLEY, K.S., JUSTICE, L.M. and O'CONNELL, A.A., 2020. Early childhood educators' knowledge about language and literacy: Associations with practice and children's learning. *Dyslexia* [online], 26 (2), pp. 137 - 152. Available from: https://doi-org.edgehill.idm.oclc.org/10.1002/dys.1612 (Accessed 5 June 2020)

POTTS, R. and SHANKS, D.R., 2014. The benefit of generating errors during learning. *Journal of Experimental Psychology General* [outline]. 143 (2), pp. 644 - 667. Available from: https://doi:10.1037/a0033194 (Accessed 15 July 2018).

PYC, M.A. and RAWSON, K.A., 2009. Testing the retrieval effort hypothesis: Does greater difficulty correctly recalling information lead to higher levels of memory? *Journal of Memory and Language* [online]. 60 (4), pp. 437 – 447. Available from: https://doi.org/10.1016/j.jml.2009.01.004 (Accessed 20 April 2017).

RATCLIFFE, M., BARTHOLOMEW, H., HAMES, V., HIND, A., LEACH, J., MILLAR, R. and OSBORNE, J., 2005. Evidence-based Practice in Science Education: The Researcher–User Interface. *Research Papers in Education* [online]. 20 (2), pp. 169 – 186. Available from: https://doi.org/10.1080/02671520500078036 (Accessed 20 November 2016)

REED, D.K., RIMEL, H. and HALLETT, A., 2016. Note-Taking Interventions for College Students: A Synthesis and Meta-Analysis of the Literature. *Journal of Research on Educational Effectiveness* [online]. 9 (3), pp. 307 - 333. Available from: https://doi.org/10.1080/19345747.2015.1105894 (Accessed 15 November 2016)

RESEARCH COUNCILS UK. 2013. *RCUK Policy on Open Access and Supporting Guidance*. Available from: www.rcuk.ac.uk/documents/documents/rcukopenaccesspolicy-pdf (Accessed 2 December 2016)

RESEARCHED. 2016. *ResearchED Homepage*. Available from: http://www.workingoutwhatworks.com/en-GB (Accessed from 11 December 2016)

REYES-CRUZ. M., RUEDA DE LEÓN-BARBOSA, L. and MURRIETA-LOYO. G., 2017. Undergraduate Pre-service EFL Teachers' Conceptions of Research: A Quantitative Analysis. *Colomb. Appl. Linguist. J.,* 19 (1), pp. 67 - 83.

RICHARDSON, J.W., SAUERS, N., CHO, V., and LINGAT, J.E., 2020. How school leaders use Twitter for Knowledge Brokering. In: In J. R. Malin and C. Brown, eds. *The role of knowledge brokers in education: Connecting the dots between research and practice.* New York, NY: Routledge. pp. 27 - 39.

RICHLAND, L.E., KORNELL, N. and KAO, L.S., 2009. The pretesting effect: Do unsuccessful retrieval attempts enhance learning? *Journal of Experimental*

*Psychology: Applied* [online]. 15 (3), pp. 243 - 257. Available from: https://doi:10.1037/a0016496 (Accessed 3 October 2019)

RIGGALL, A. and SINGER, R. 2016. *Research Leads: current practice, future prospects*. Berkshire: Education Development Trust.

ROEDIGER, H.L. and BUTLER, A.C., 2011. The critical role of retrieval practice in long-term retention. *Trends in cognitive sciences* [online], *15* (1), pp. 20 - 27. Available from: https://doi.org/10.1016/j.tics.2010.09.003 (Accessed 30 April 2017)

ROSE, J., THOMAS, S., ZHANG, L., EDWARDS, A., AUGERO, A. and RONEY, P., 2017. *Research Learning Communities: Evaluation Report and Executive Summary*. Education Endowment Foundation. Available from: https://educationendowmentfoundation.org.uk/projects-and-evaluation/projects/research-learning-communities/ (Accessed 10 January 2018).

ROYAL SOCIETY, 2011. *Brain Waves Module 2: Neuroscience implications for education and lifelong learning*. London: The Royal Society.

RYLE, G., 1949. Knowing How and Knowing That: The Presidential Address. *Proceedings of the Aristotelian Society* [online]. 46, pp. 1 - 16. Available from: http://www.jstor.org/stable/4544405 (Accessed 3 January 2017)

SAHOTA, P., WOODWARD, J., MOLINARI, R. and PIKE, J., 2014. Factors influencing take-up of free school meals in primary- and secondary-school children in England. *Public Health Nutrition* [online]. 17 (6), pp. 1271 - 1279. Available from: https://doi.org/10.1017/S136898001300092X (Accessed 15 July 2019).

SARAFINO, E.P., RUSSO, A., BARKER, J., CONSENTINO, A. and CONSENTINO, A., 1982. The effect of rewards on intrinsic interest: Developmental changes in the underlying processes. *The Journal of Genetic Psychology: Research and Theory on Human Development* [online]. 141 (1), pp. 29 – 39. Available from: https://doi.org/10.1080/00221325.1982.10533454 (Accessed 29 June 2018).

SCHÖN, D., 1987. *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions*. San Francisco, CA: Jossey-Bass.

SCHULMAN, L., 1987. Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review* [online]. 57 (1), pp. 1 – 22. Available from: https://doi.org/10.17763/haer.57.1.j463w79r56455411 (Accessed 1 July 2017).

SCOTT, T., MANNION, R., DAVIES, H. and MARSHALL, M., 2003. The quantitative measurement of organizational culture in health care: a review of the available instruments. *Health services research* [online]. 38 (3), pp. 923-945. Available from: https://doi.org/10.1111/1475-6773.00154 (Accessed 10 December 2019).

SEBBA, J., 2004. Developing Evidence-Informed Policy and Practice in Education. In: G. Thomas and R. Pring, eds., 2004. *Evidence-Based Practice in Education*. Berkshire: Open University Press. pp. 34 - 43.

SEIDENBERG, M S., 2017. *Language at the speed of sight*. New York: Basic Books

SHALEM, Y., and SLONIMSKY, L., 2013. Practical knowledge of teaching practice: What Counts. In: B. Barrett and E. Rata, eds., 2013. *Knowledge and the Future of the Curriculum*. Palgrave Macmillan, London. pp. 198 – 229.

SIMBO, F.K., 1988. The Effects of Notetaking Approach es on Student Achievement in Secondary School Geography. *The Journal of Educational Research* [online]. 81 (6), pp. 377 - 381. Available from: https://DOI10.1080/00220671 (Accessed 10 December 2017).

SLAMECKA, N.J. and KATSAITI, L.T., 1988. Normal forgetting of verbal lists as a function of prior testing. *Journal of Experimental Psychology: Learning, Memory, and Cognition* [online]. 14 (4), pp. 716 – 727. Available from: https://doi.org/10.1037/0278-7393.14.4.716. (Accessed 10 April 2017).

SLAVIN, R.E., 1990. Achievement effects of ability grouping in secondary schools: A best-evidence synthesis. *Review of educational research* [online], 60 (3), pp. 471 - 499. Available from: https://doi.org/10.3102/00346543060003471 (Accessed 1 February 2018)

SLAVIN, R.E., 2002. Evidence-based education policies: Transforming educational practice and research. *Educational Researcher* (online). 31 (7), pp. 15 - 21. Available from: https://doi.org/10.3102%2F0013189X031007015 (Accessed 1 December 2016).

SLAVIN, R.E., 2004. Education research can and must address "What Works" questions. *Educational Researcher* [online]. 33 (1), pp. 27 - 28. Available from: http://www.indiana.edu/~educy520/sec6342/week_05/slavin04whatworks.pdf (Accessed 1 December 2016)

SLAVIN, R., LEAVEY, M. and MADDEN, N., 1984. Combining cooperative learning and individualized instruction: Effects on student mathematics achievement, attitudes, and behaviors. *Elementary School Journal*. 84, pp. 409 - 422.

SMITH, S.W., DAUNIC, A. and TAYLOR, G., 2007. Treatment fidelity in applied educational research: Expanding the adoption and application of measures to ensure evidence-based practice. *Education and treatment of children* [online]. 30 (4), pp. 121 - 134. Available from: https://doi.org/10.1353/etc.2007.0033 (Accessed 10 May 2018).

SNOOK, I., CLARK, J., HARKER, R., O'NEIL, A. and O'NEIL, J., 2010. Critic and Conscience of Society: A Reply to John Hattie. *New Zealand Journal of Educational Studies* [online]. 45 (2), pp. 93 - 98. Available from: http://search.proquest.com/openview/a3794f1f1f4a61fb183e7 (Accessed 6 November 2016).

STERNBERG, R., 2001. Why Schools Should Teach for Wisdom: The Balance Theory of Wisdom in Educational Settings. *Educational Psychologist [online]*. 36 (4), pp. 227 - 245. Available from: https://doi.org/10.1207/S15326985EP3604_2 (Accessed 24 March 2017).

SOBEL, H.S., CEPEDA, N.J. and KAPLER, I., 2011. Spacing effects in real-world classroom vocabulary learning. *Applied Cognitive Psychology* [online]. 25 (5), pp. 763 - 767. Available from: https://doi.org/10.1002/acp.1747 (Accessed 28 November 2018).

SOUVIGNIER, E. and KRONENBERGER, J., 2007. Cooperative learning in third graders' jigsaw groups for mathematics and science with and without questioning training. *British Journal of Educational Psychology* [online]. 77 (4), pp. 755 - 771. Available from: https://doi.org/10.1348/000709906X173297 (Accessed 20 November 2017).

STANISLAW, H. and TODOROV, N., 1999. Calculation of signal detection theory measures. *Behaviour Research Methods, Instruments, & Computers* [online]. 31 (1), pp. 137 - 149. Available from: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.453.5684&rep=rep1&type=pdf (Accessed 28 December 2016)

STEVENS, R.J., 2004. Why educational innovations come and go? What do we know? What can we do? *Teaching and Teacher Education* [online]. 20, pp. 389 – 396. Available from: https://doi.org/10.1016/j.tate.2004.02.011 (Accessed 25 December 2016).

STRONGE, J.H., WARD, T.J., TUCKER, P.D. and HINDMAN, J.L., 2007. What is the relationship between teacher quality and student achievement? An exploratory study. Journal of Personnel Evaluation in Education [online]. 20 (3-4), pp. 165 - 184. Available from: https://doi.org/10.1007/s11092-008-9053-z (Accessed 3 July 2020).h

STOLBERG, H., NORMAN, G. and TROP, I., 2004. Fundamentals of clinical research for radiologists: randomized controlled trials. *American Journal of Roentgenolog*y [online]. 183, pp. 1539 – 1544. Available from: http://www.ajronline.org/doi/abs/10.2214/ajr.183.6.01831539 (Accessed 4 December 2016).

STOLL, L., BOLAM, R., MCMAHON, A., WALLACE, M. and THOMAS, S., 2006. Professional learning communities: A review of the literature. *Journal of educational change* [online]. 7 (4), pp. 221 - 258. Available from: https://doi.org/10.1007/s10833-006-0001-8 (Accessed 10 June 2017).

SULLIVAN, G., 2011. Getting Off the ''Gold Standard'': Randomized Controlled Trials and Education Research. *Journal of Graduate Medical Education* [online]. 3 (3), pp. 285 - 299. Available from: https://doi.org/10.4300/JGME-D-11-00147.1 (Accessed 15 December 2018).

TABER, K.S., 2017. The use of cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education* [online]. 48, pp. 1273 – 1296. Available from: http://doi10.1007/s11165-016-9602-2 (Accessed 1 December 2018)

TASHAKKORI, A. and TEDDIE, C., 2003. Issues and dilemmas in teaching research methods courses in social and behavioural sciences: US perspective. *International Journal of Social Research Methodology* [online]. 6 (1), pp. 61 - 77. Available from: https://doi.org/10.1080/13645570305055 (Accessed 10 July 2019).

TAYLOR, C., 2018. The Reliability of Free School Meal Eligibility as a Measure of Socio-Economic Disadvantage: Evidence from the Millennium Cohort Study in Wales, *British Journal of Educational Studies* [online]. 66 (1), pp. 29 - 51. Available from: https://doi.org/10.1080/00071005.2017.1330464 (Accessed December 2018)

TERHART, E., 2011. Has John Hattie really found the holy grail of research on teaching? An extended review of Visible Learning. *Journal of Curriculum Studies* [online]. 43 (3), pp. 425 - 438. Available from: http://www.tandfonline.com/toc/tcus20/ (Accessed 5 November 2016).

THE WELLCOME TRUST, 2014. *How neuroscience is affecting education* [online]. Available from: https://wellcome.ac.uk/stellent/groups/ (Accessed 11 December 2017).

TOOLEY, J. and DARBY, D., 1998. *Educational research: A critique*. London: OFSTED.

TOPPING, K. J., THURSTON, A., TOLMIE, A., CHRISTIE, D., MURRAY, P. and KARAGIANNIDOU, E., 2011. Cooperative learning in science: intervention in the secondary school. *Research in Science & Technological Education* [online]. 29 (1), pp. 91 - 106. Available from: https://doi.org/10.1080/02635143.2010.539972 (Accessed 20 July 2018).

TORGESON, C., BROOKS, G., GASCOINE, L. and HIGGINS, S., 2018. Phonics: reading policy and the evidence of effectiveness from a systematic 'tertiary' review. *Research Papers in Education* [online]. 34 (2), pp. 1 - 31. Available from: https://doi.org/10.1080/02671522.2017.1420816 (Accessed 11 November 2019).

TORGERSON, C. and TORGERSON, D., 2001. The Need for Randomised Controlled Trials in Educational Research. *British Journal of Educational Studies* [online]. 49 (3), pp. 316 - 328. Available from: https://doi.org/10.1111/1467-8527.t01-1-00178 (Accessed 10 February 2019).

TOWNSEND, S., 1995. *The Effects of Vocabulary Homework on Third-grade Achievement*. Unpublished thesis (Masters). Kean College of Jersey. Available from: https://www.researchgate.net/publication/234712620 (Accessed 22 October 2016)

TRIPNEY, J., KENNY, C. and GOUGH, D., 2014. Enabling the Use of Research Evidence Within Educational Policymaking in Europe: Lessons from the EIPEE Project. *Journal of European Education* [online]. 46 (1), pp. 55 - 74. Available from: http://dx.doi.org/10.2753/EUE1056-4934460103 (Accessed 27 October 2016).

VAN SCHAIK, P., VOLMAN, M., ADMIRAAL, W. and SCHENKED, W., 2018. Barriers and conditions for teachers' utilisation of academic knowledge. *International Journal of Educational Research* [online], 90, pp. 50 – 63. Available from: https://doi.org/10.1016/j.ijer.2018.05.003 (Accessed 2 June 2019)

VANDERLINDE, R. and VAN BRAAK, J., 2010. The gap between educational research and practice: views of teachers, school leaders, intermediaries and researchers. *British Educational Research Journal* [online]. 36 (2), pp. 299 - 316. Available from: http://dx.doi.org/10.1080/01411920902919257 (Accessed 28 October 2016).

VEENMAN, M. V., VAN HOUT-WOLTERS, B. H. and AFFLERBACH, P., 2006. Metacognition and learning: Conceptual and methodological considerations. *Metacognition and Learning* [online]. 1 (1), pp. 3 - 14. Available from: https://doi:10.1007/s11409-006-6893-0 (Accessed 27 May 2018).

VLACH, H.A. and SANDHOFER, C.M., 2012. Distributing learning over time: The spacing effect in children's acquisition and generalization of science concepts. *Child development* [online]. 83 (4), pp. 1137 - 1144. Available from: https://doi.org/10.1111/j.1467-8624.2012.01781.x (Accessed 18 November 2018)

WATKINS, M., LEI, P. and CANIVEZ, G., 2007. Psychometric intelligence and achievement: A cross-lagged panel analysis. *Intelligence* [online]. 35 (1), pp. 59-68. Available from: https://doi.org/10.1016/j.intell.2006.04.005 (Accessed 1 February 2020)

WEISS, C., 1979. The Many Meanings of Research Utilization. *Public Administration Review* [online]. 39 (5), pp. 426 - 432. Available from: https://www.jstor.org/stable/3109916 (Accessed 30 December 2016)

WELLS, T., BAILEY, J.T. and LINK, M.W., 2014. Comparison of Smartphone and Online Computer Survey Administration. *Social Science Computer Review* [online].

32 (2), pp. 238 – 255. Available from: https://doi.org/10.1177%2F0894439313505829 (Accessed 13 September 2017).

WHICKER, K.M., BOL, L. and NUNNERY, J.A., 1997. Cooperative learning in the secondary mathematics classroom. *The Journal of Educational Research* [online]. 91 (1), pp. 42 - 48. Available from: https://doi.org/10.1080/00220679709597519 (Accessed 2 January 2017).

WHITTY, G., 2006. Education(al) research and education policy making: Is conflict inevitable? *British Educational Research Journal* [online]. 32, pp. 159 – 176. Available from: https://doi.org/10.1080/01411920600568919 (Accessed 24 June 2020)

WHITTY, G., 2013. *Evidence-informed policy and practice – we should welcome it, but also be realistic!* [online]. Available from: https://cerp.aqa.org.uk/perspectives/evidence-informed-policy-practice (Accessed 28 May 2018)

WIESER, C., 2016. Teaching and personal educational knowledge – conceptual considerations for research on knowledge transformation. *European Journal of Teacher Education* [online]. 39 (5), pp. 2 - 16. Available from: https://doi.org/10.1080/02619768.2016.1253673 (Accessed 15 November 2017).

WILHELM, A.G. and ANDREWS-LARSON, C., 2016. Why don't teachers understand our questions? Reconceptualizing teachers' "misinterpretation" of survey items. *AERA Open* [online]. 2 (2), pp. 1 - 13. Available from: https://doi.org/10.1177%2F2332858416643077 (Accessed 10 May 2020).

WILIAM, D. and BARTHOLOMEW, H., 2004. It's not which school but which set you're in that matters: The influence of ability grouping practices on student progress in mathematics. *British Educational Research Journal* [online]. 30 (2), pp. 279 - 293. Available from: https://doi.org/10.1080/01411920500148663 (Accessed 18 July 2017)

WILIAM, D., LEE, C., HARRISON, C. and BLACK, P., 2004. Teachers developing assessment for learning: Impact on student achievement. *Assessment in Education* [online]. 11 (1), pp. 49 - 65. Available from: https://doi.org/10.1080/0969594042000208994 (Accessed 14 November 2016).

WILLIAMS, R.H. and ZIMMERMAN, D.W., 1996. Are simple gain scores obsolete? *Applied Psychological Measurement* [online]. 20 (1), pp. 59 - 69. Available from: https://doi.org/10.1177%2F014662169602000106 (Accessed 20 April 2017).

WILLINGHAM, D., 2009. *Why Don't Students Like School?: A Cognitive Scientist Answers Questions About How the Mind Works and What It Means for the Classroom*. San Francisco: Jossey Bass

WILLSON, V. and PUTNAM, R., 1982. A meta-analysis of pretest sensitization effects in experimental design. *American Educational Research Journal* [online]. *19* (2), pp. 249 - 258. Available from: https://doi.org/10.3102/00028312019002249 (Accessed 5 January 2020)

WINCH, C., OANCEA, A. and ORCHARD, J., 2015. The contribution of educational research to teachers' professional learning: philosophical understandings. *Oxford Review of Education* [online]. 41 (2), pp. 202 - 216. Available from: http://dx.doi.org/10.1080/03054985.2015.1017406 (Accessed 19 December 2016).

WINNE, P.H., 1996. A metacognitive view of individual differences in self-regulated learning. *Learning and individual differences* [online], 8 (4), pp. 327 - 353. Available from: https://doi.org/10.1016/S1041-6080(96)90022-9 (Accessed 10 March 2018).

WINNE, P.H. and NESBIT, J.C., 2010. The Psychology of Academic Achievement. *Annual Review of Psychology* [online]. 61, pp. 653 - 678. Available from: http://www.annualreviews.org/doi/abs/10.1146/annurev.psych.093008.100348?journalCode=psych (Accessed 20 November 2016).

WINTOUR, P., 2014. Compulsory setting: schools face being forced to separate pupils by ability. *The Guardian* [online]. 3 September. Available from: http://www.theguardian.com/politics/2014/sep/03/schools-separate-pupils-ability-setting (Accessed 1 September 2017).

WRIGHT, T., 2009. *How to be a Brilliant Teacher*. London: Routledge

WRIGLEY, T., 2018. The power of 'evidence': Reliable science or a set of blunt tools? *British Educational Research Journal* [online]. 44 (3), pp. 359 – 376. Available from: https://doi.org/10.1002/berj.3338 (Accessed 10 August 2019).

WYSE, D. and TORGERSON, C., 2017. Experimental trials and 'what works?' in education: The case of grammar for writing. *British Educational Research Journal* [online]. *43* (6), pp. 1019 - 1047. Available from: https://doi.org/10.1002/berj.3315 (Accessed 10 December 2018).

ZECHMEISTER, E.B. and SHAUGHNESSY, J.J., 1980. When you know that you know and when you think that you know but you don't. *Bulletin of the Psychonomic Society* [online]. 15**,** pp. 41 – 44. Available from: https://doi.org/10.3758/BF03329756 (Accessed 10 January 2019)

ZWICK, W. and VELICER, W., 1986. Comparison of Five Rules for Determining the Number of Components to Retain*. Psychological Bulletin* [online]. 99 (3), pp. 432 - 442. Available from: https://psycnet.apa.org/doi/10.1037/0033-2909.99.3.432 (Accessed 7 June 2019)

**Appendix 1. School Survey (PDF copy to help maintain layout of original survey)**

# How Research-informed Is Your School?

## Page 1: Study Information

Dear teacher,

As you will likely be aware, your school are participating in a study that aims to identify the extent to which engagement with educational research can affect teachers' professional practice within mainstream secondary schools in England.

As the person responsible for teachers' professional development within your school, you are being asked to complete a survey created to identify what steps your school takes to provide research-informed education. We would also like to know how important you perceive each of those steps to be in creating a research-informed school.

All information that you provide is confidential. At the end of the questionnaire, you will be given a Participant ID which is linked to your name and the school in which you work. This information, along with the data that you provide in this questionnaire, will be stored in a locked file and/or password-protected computer file to which only my research supervisory team and I (Scott Clarke) will have access. Should the results of this study be published, neither your name nor any information that identifies you will be included.

You will receive no incentive for participation. Your participation will help us better understand the impact of engaging with educational research on teaching practice. There are no risks associated with participation.

You are free to withdraw from the study at any time within five weeks from the date of your submission. You do not need to provide a reason and you will not be penalised in any way. You may withdraw the data by contacting Scott Clarke (clarkes@edgehill.ac.uk) and providing your name and/or Participant ID.

QUERY/COMPLAINT: This project has been approved by the Faculty Research Ethics Committee at Edge Hill University. If you wish to raise any queries or concerns about the ethical dimension of this project with an independent person, please contact Joanne Morris, Secretary to the University Research Ethics Committee (morrisjo@edgehill.ac.uk).

QUESTIONS: If you have questions about how or why this research is being conducted, please contact Scott Clarke (clarkes@edgehill.ac.uk) and include your name and/or Participant ID. Alternatively, you may contact the researcher's Director of Studies, Professor Tim Cain (caint@edgehill.ac.uk). If you would like to receive a summary of the study results, please provide your email address below.

Scott Clarke (BSc, MSc, MA, PGCE, QTLS)

PhD Candidate – Graduate Teaching Assistant

Faculty of Education

Edge Hill University

Ormskirk, L39 4QP

## Page 2: Consent To Participate

Please read each statement and, if you agree to all statements, complete the signature section below:

1. I have read and understood the study information.
2. I understand the purpose of completing this survey and the procedure that will take place.
3. I agree to participate in completing this survey.
4. I understand that I may later withdraw the data that I have provided from the study until five weeks from today's date without penalty and without giving a reason.
5. I have the right to receive a summary of the study results if I choose. If I wish to receive this information, I will include my email address below.

1. Print Name:

[ ]

2. Date:

Dates need to be in the format 'DD/MM/YYYY', for example 27/03/1980.

[ ]

(dd/mm/yyyy)

## Page 3: Survey Structure

This survey consists of two sections.

You will initially be asked questions about the steps that your school takes to becoming research-informed. This will help us identify how driven your school is to do so. Immediately following each question, you will be presented with a scale and asked to provide your opinion about how important you believe the respective step(s) is in developing a research-informed school. If you're unsure, you should select the middle point within the scale.

You will then be asked a series of questions to identify basic details about your role within the school.

## Page 4: How Research-informed Is Your School?

*3.* Our school leaders take evidence from research findings into account when (tick all that apply):

- ☐ Creating policy
- ☐ Implementing new initiatives (e.g., adoption of teaching strategies)
- ☐ Deploying resources (e.g., allocating Teaching Assistants)
- ☐ None of the above
- ☐ Other

*3.a.* If you selected Other, please specify:

*3.b.* To create a research-informed school, how important is it that **school leaders use research in their decision-making?**

| | | | | | | |
|---|---|---|---|---|---|---|
| Not Important | ☐ | ☐ | ☐ | ☐ | ☐ | Highly Important |

*4.* To support teachers in *conducting* research, our school provides (tick all that apply):

- ☐ Financial support
- ☐ Allocated research time
- ☐ Access to academic resources (e.g., research journals)
- ☐ Access to a mentor
- ☐ Support from a Research-Lead (or similar)
- ☐ None of the above
- ☐ Other

4.a. If you selected Other, please specify:

4.b. To create a research-informed school, how important is it that **teachers are supported in conducting research?**

| | | | | | | |
|---|---|---|---|---|---|---|
| Not Important | ☐ | ☐ | ☐ | ☐ | ☐ | Highly Important |

5. To support teachers in *using* research, our school provides (tick all that apply):

- ☐ Allocated research time
- ☐ Access to academic resources (e.g., research journals)
- ☐ Access to a mentor
- ☐ Support from a Research-Lead (or similar)
- ☐ Access to research-focused training programmes
- ☐ Research reading groups
- ☐ None of the above
- ☐ Other

5.a. If you selected Other, please specify:

5.b. To create a research-informed school, how important is it that **teachers are supported in using research?**

| | | | | | | |
|---|---|---|---|---|---|---|
| Not Important | ☐ | ☐ | ☐ | ☐ | ☐ | Highly Important |

6. To what extent does your school encourage groups of staff (e.g. departments) to use research when making decisions:

| | | | | | | |
|---|---|---|---|---|---|---|
| Rarely | ☐ | ☐ | ☐ | ☐ | ☐ | Often |

6.a. To create a research-informed school, how important is it that **the school encourages groups of staff (e.g. departments) to use research when making decisions?**

| | | | | | | |
|---|---|---|---|---|---|---|
| Not Important | ☐ | ☐ | ☐ | ☐ | ☐ | Highly Important |

7. There is a Research-Lead role (or similar) at our school

- ○ Yes
- ○ No

7.a. To create a research-informed school, how important is it **to have a Research-Lead (or equivalent) at the school?**

| | | | | | | |
|---|---|---|---|---|---|---|
| Not Important | ☐ | ☐ | ☐ | ☐ | ☐ | Highly Important |

8. The person responsible for teachers' professional development regularly communicates with all teaching staff to provide (tick all that apply):

- ○ CPD opportunities (e.g., courses)
- ○ Research-based academic resources
- ○ Opportunities to become involved in research with other schools
- ○ Opportunities to collaborate with colleagues in research activity
- ○ Opportunities to become involved in research projects with universities
- ○ Other

8.a. If you selected Other, please specify:

8.b. To create a research-informed school, how important is it that **the person responsible for teachers' professional development regularly communicates with all teaching staff?**

| | | | | | | |
|---|---|---|---|---|---|---|
| Not Important | ☐ | ☐ | ☐ | ☐ | ☐ | Highly Important |

9. How regularly does the person responsible for teachers' professional development communicate with HE institutions and/or external bodies (e.g., Education Endowment Foundation)

| | | | | | | |
|---|---|---|---|---|---|---|
| No Regular Contact | ☐ | ☐ | ☐ | ☐ | ☐ | Very Regular Contact |

9.a. To create a research-informed school, how important is it that **the person responsible for teachers' professional development regularly communicates with HE institutions and/or external bodies?**

| | | | | | | |
|---|---|---|---|---|---|---|
| Not Important | ☐ | ☐ | ☐ | ☐ | ☐ | Highly Important |

10. Research is used within our school to create a culture of (tick all that apply):

- ☐ Reflectivity
- ☐ Criticality
- ☐ Creativity
- ☐ None of the above
- ☐ Other

10.a. If you selected Other, please specify:

10.b. To create a research-informed school, how important is it that **research is used to develop the selected cultural qualities?**

| | | | | | | |
|---|---|---|---|---|---|---|
| Not Important | ☐ | ☐ | ☐ | ☐ | ☐ | Highly Important |

11. To what extent are teachers are encouraged to consider research that challenges their conceptions about teaching & learning?

| | | | | | | |
|---|---|---|---|---|---|---|
| Rarely Encouraged | ☐ | ☐ | ☐ | ☐ | ☐ | Strongly Encouraged |

11.a. To create a research-informed school, how important is it that **teachers are encouraged to consider research that challenges their conceptions about teaching & learning?**

| | | | | | | |
|---|---|---|---|---|---|---|
| Not Important | ☐ | ☐ | ☐ | ☐ | ☐ | Highly Important |

12. How many teachers are involved in the following activities (tick all that apply):

| | None | Some Teachers | Most Teachers | All Teachers |
|---|---|---|---|---|
| School-based research conferences | ☐ | ☐ | ☐ | ☐ |
| School-based publications (e.g., journals) | ☐ | ☐ | ☐ | ☐ |
| School-based CPD days (or similar) | ☐ | ☐ | ☐ | ☐ |
| Regular staff briefings | ☐ | ☐ | ☐ | ☐ |
| Research reading groups | ☐ | ☐ | ☐ | ☐ |

| | | | | |
|---|---|---|---|---|
| No research activity | ☐ | ☐ | ☐ | ☐ |
| Other | ☐ | ☐ | ☐ | ☐ |

*12.a.* If you selected Other, please describe:

*12.b.* To create a research-informed school, how important is it that **teachers are regularly involved in activities that encourage research engagement?**

| | | | | | | |
|---|---|---|---|---|---|---|
| Not Important | ☐ | ☐ | ☐ | ☐ | ☐ | Highly Important |

*13.* To what extent are collaborations with external partners used purposely to challenge teachers' conceptions about teaching & learning:

| | | | | | | |
|---|---|---|---|---|---|---|
| None | ☐ | ☐ | ☐ | ☐ | ☐ | A lot |

*13.a.* To create a research-informed school, how important is it that **collaborations with external partners are used purposely to challenge teachers' conceptions about teaching & learning?**

| | | | | | | |
|---|---|---|---|---|---|---|
| Not Important | ☐ | ☐ | ☐ | ☐ | ☐ | Highly Important |

*14.* Our school has the following quality assurance procedures in place to ensure that reseach we *conduct* is high-quality (tick all that apply):

- ☐ Ongoing access to an academic mentor/ supervisor
- ☐ Research proposals must be approved
- ☐ Provide access to academic resources

- ☐ Conduct workshops for researchers
- ☐ Communication with a teaching-school
- ☐ Our School has no quality assurance procedures to ensure research quality
- ☐ Other

*14.a.* If you selected Other, please specify:

| |
|---|
| |

*14.b.* To create a research-informed school, how important is it that **quality assurance procedures are implemented to ensure conducted research is high-quality?**

| | | | | | | |
|---|---|---|---|---|---|---|
| Not Important | ☐ | ☐ | ☐ | ☐ | ☐ | Highly Important |

*15.* To what extent is research used as a tool to promote professional dialogues amongst eachers:

| | | | | | | |
|---|---|---|---|---|---|---|
| Not at all | ☐ | ☐ | ☐ | ☐ | ☐ | A lot |

*15.a.* To create a research-informed school, how important is it that research is used as a ool to promote professional dialogues amongst teachers?

| | | | | | | |
|---|---|---|---|---|---|---|
| Not Important | ☐ | ☐ | ☐ | ☐ | ☐ | Highly Important |

*16.* Our school supports all teachers in undertaking post-graduate study through (tick all hat apply):

- ☐ Financial support
- ☐ Study-allocated time

- [ ] Providing a mentor
- [ ] Providing additional CPD opportunities
- [ ] Our school does not support teachers in undertaking post-graduate study
- [ ] Other

*16.a.* If you selected Other, please specify:

*16.b.* To create a research-informed school, how important is it that teachers **are supported in undertaking post-graduate study?**

| | | | | | | |
|---|---|---|---|---|---|---|
| Not Important | ☐ | ☐ | ☐ | ☐ | ☐ | Highly Important |

*17.* Our school has the following quality assurance procedures in place to ensure that reseach we *use* is high-quality (tick all that apply):

Please select at least 1 answer(s).

- [ ] Ongoing access to an academic mentor (or equivalent)
- [ ] Access to academic, peer-reviewed journals
- [ ] Provide research-focused workshops for staff
- [ ] Communication with a teaching-school
- [ ] Research must meet specific methodological criteria for it to be used
- [ ] Our School has no quality assurance procedures to ensure research quality
- [ ] Other

*17.a.* If you selected Other, please specify:

*17.b.* To create a research-informed school, how important is it that **quality assurance procedures are implemented to ensure research *used* is high-quality?**

| | | | | | | |
|---|---|---|---|---|---|---|
| Not Important | ☐ | ☐ | ☐ | ☐ | ☐ | Highly Important |

## Page 5: Your Role

18. Job Title:

19. Managerial Responsibilities:

- Senior Leadership
- Middle-management
- No Managerial Resonsibilities
- Other

19.a. If you selected Other, please specify:

20. Highest Academic Qualification (ranked lowest to highest):

- Undergraduate Degree (e.g., BSc, BA)
- PGCE (or equivalent)
- Post-graduate Degree (e.g., MA, MSc, MRes)
- PhD
- Other

20.a. If you selected Other, please specify:

## Page 6: Study Debrief

Thank you for your participation.

By completing this survey you have helped us understand the various approaches that secondary schools take to developing a research-informed practice.

Please provide your email address below if you would like to be provided with a summary of the current research findings.

21. Email:

Yours Sincerely,

Scott Clarke (BSc, MSc, MA, PGCE, QTLS)

PhD Candidate – Graduate Teaching Assistant

Faculty of Education

Edge Hill University

Ormskirk, L39 4QP

**Appendix 2. Teacher Survey (PDF version to help maintain layout of original survey)**

# Teaching Principles and Engagement with Research

## Study Information

Dear teacher,

The goal of this study is to identify the extent to which engagement with educational research can affect teachers' professional practice within mainstream secondary schools in England.

You will be asked to complete a questionnaire containing statements about teaching practices. We would like to know whether you think that each of these statements are, or are not, supported by research findings. You will also be asked to provide basic socio-demographic details (e.g., highest academic qualification, subject specialism) and to answer a few questions about how educational research affects your teaching and learning practices.

All information that you provide is confidential. At the end of the questionnaire, you will be given a Participant ID which is linked to your name and the school in which you work. This information, along with the data that you provide in this questionnaire, will be stored in a locked file and/or password-protected computer file to which only my research supervisory team and I (Scott Clarke) will have access. Should the results of this study be published, neither your name nor any information that identifies you will be included.

You will receive no incentive for participation. Your participation will help us better understand the impact of engaging with educational research on teaching practice. There are no risks associated with participation.

You are free to withdraw from the study at any time within five weeks from the date of your submission. You do not need to provide a reason and you will not be penalised in any way. You may withdraw the data by contacting Scott Clarke (clarkes@edgehill.ac.uk) and providing your name and/or Participant ID.

QUERY/COMPLAINT: This project has been approved by the Faculty Research Ethics Committee at Edge Hill University. If you wish to raise any queries or concerns about the ethical dimension of this project with an independent person, please contact Joanne Morris, Secretary to the University Research Ethics Committee (morrisjo@edgehill.ac.uk).

QUESTIONS: If you have questions about how or why this research is being conducted, please contact Scott Clarke (clarkes@edgehill.ac.uk) and include your name and/or Participant ID. Alternatively, you may contact the researcher's Director of Studies, Professor Tim Cain (caint@edgehill.ac.uk). If you would like to receive a summary of the study results, please provide your email address below.

Scott Clarke (BSc, MSc, MA, PGCE, QTLS)

PhD Candidate – Graduate Teaching Assistant

Faculty of Education

Edge Hill University

Ormskirk, L39 4QP

## Consent to Participate

Please read each statement and, if you agree to all statements, complete the signature section below:

1. I have read and understood the study information.
2. I understand the purpose of completing this questionnaire and the procedure that will take place.
3. I agree to participate in completing this questionnaire.
4. I understand that I may later withdraw the data that I have provided from the study until five weeks from today's date without penalty and without giving a reason.
5. I have the right to receive a summary of the study results if I choose. If I wish to receive this information, I will include my email address below.

1. Print name:

2. Date:

Dates need to be in the format 'DD/MM/YYYY', for example 27/03/1980.

(dd/mm/yyyy)

## Questionnaire Structure

This questionnaire consists of two sections.

In Section One, you will be asked to provide basic socio-demographic details (e.g., age, subject specialism). Following that, you will be asked about steps that you, and the setting in which you teach, take to keep your knowledge of research findings current.

In Section Two, you will be asked to use your knowledge of educational research findings to determine whether certain teaching practices enhance student achievement.

## Section One: Socio-demographics

3. What is the name of the school in which you teach?

3.a. In what area is this school?

4. Subject Speciality:

- English
- Maths
- Sciences (e.g., Biology, Chemistry, Physics)
- Social Sciences
- Vocational
- PE/ Performing Arts
- Humanities (e.g., Geography, History, RE)
- Modern Foreign Languages
- Other

4.a. If selected 'Other', please state below

5. Job Title:

- Head Teacher
- Assistant Head Teacher
- Head of Department/ Head of Year
- Assistant Head of Department/ Assistant Head of Year
- Classroom Teacher
- NQT
- Other

6. Age:

- Under 21 years
- 21-30 years
- 31-40 years
- 41-50 years
- 51-60 years
- 60+ years

7. Number of years teaching experience in secondary schools:

- Less than 1 year
- 1-3 years
- 4-7 years
- 8-11 years
- +12 years

8. Highest Academic Qualification (ranked lowest to highest):

- Undergraduate Degree (e.g., BSc, BA)
- PGCE (or equivalent)
- Post-graduate Degree (e.g., MSc, MA, MRes)
- PhD
- Other

8.a. If selected 'Other', please state below

## Section One: Engagement with Research

9. How appropriately can educational research findings be used to guide *general* educational practice?

- 0 - Not Appropriate
- 1
- 2
- 3
- 4 - Highly Appropriate

9.a. For what reason(s) do you consider educational research findings to be inappropriate for guiding educational practice?

9.b. What are the benefits of using educational research findings to guide educational practice?

10. To what extent is *your* teaching practice influenced by educational research findings?

- 0 - Not Influenced
- 1
- 2
- 3
- 4 - Highly Influenced

10.a. In what ways do educational research findings influence your practice?

10.b. What obstacles do you face in using educational research findings to influence your practice?

## Section One: Engagement with Educational Research

11. Please tick any resources that you typically utilise to ensure that your knowledge of educational research findings remains current

- ☐ Academic journals
- ☐ Discussion with peers
- ☐ Social networking/ Blogs (e.g., Twitter)
- ☐ Books
- ☐ Television/ Newspapers
- ☐ Membership to professional bodies (e.g., Education & Training Foundation)
- ☐ I do not utilise any resources to keep up-to-date with research findings
- ☐ Other

11.a. If selected 'Other', please state below

11.b. If you do not utilise any resources to keep up to date with educational research findings, please explain why

12. Please tick any steps that you have taken to ensure that your knowledge of educational research findings remains current

- ☐ Masters degree in Education
- ☐ School-based CPD (e.g., INSET days)
- ☐ Research collaboration with Higher Education settings
- ☐ Research collaboration with other schools
- ☐ I have not taken any steps to ensure that my knowledge of research findings remains current
- ☐ Other

12.a. If selected 'Other', please state below

12.b. If you have not taken any steps to ensure that your knowledge of educational research findings remains current, please explain why

13. Please tick any steps that the school in which you teach take to support you in keeping up to date with educational research findings

- ☐ School-based training
- ☐ Opportunity to participate in/conduct research
- ☐ Subscription to academic educational research resources
- ☐ 'Research-lead' role (or equivalent)
- ☐ School-based funding for post-graduate study
- ☐ I am not aware of any steps that this school takes to keep up-to-date with research findings
- ☐ Other

13.a. If selected 'Other', please state below

Thank you for completing Section One.

You will now begin Section Two where you will be presented with a series of statements about the impact of teaching practices on student achievement that are either true or false according to educational research findings.

Although research findings are often inconclusive, we have selected teaching practices that are either fully supported or not supported in raising student achievement within current educational research. Please do not overthink your answer and disregard the influence of other variables (e.g., teacher quality, subject, student behaviour).

Here is an example of a statement:

'Pairing a student with an older student who can act as a mentor is an effective way to raise achievement'

You should tell us whether this statement is 'True according to research findings' or 'False according to research findings'. Here, the correct response would be 'False according to research findings' as the majority of research findings suggest mentoring is not an effective practice for raising student achievement.

## Section Two: Statements

14. We are concious of teachers' high workload, therefore the pool of questions created for this section has been halved. Please tell us whether you want to answer Question Selection A or B. * *Required*

- ○ Question Selection A
- ○ Question Selection B

## Section Two: Selection A

15. Providing feedback following formative assessment is not important to raise student achievement

- ○ True according to research findings
- ○ False according to research findings

Example item provided above. Full list of items across both QS' can be found in Appendix 3.

## Study Debrief

Thank you for your participation.

By completing this questionnaire you have helped us understand how aware secondary school teachers are of well-established, research-based teaching practices.

Please provide your email address below if you would like to be provided with:

- A document detailing the 'answers' to the questions within this questionnaire
- A selection of resources for further information about each of the teaching practices discussed
- A summary of the current research findings

67. Email:

Yours Sincerely,

Scott Clarke (BSc, MSc, MA, PGCE, QTLS)

PhD Candidate – Graduate Teaching Assistant

Faculty of Education

Edge Hill University

Ormskirk, L39 4QP

**Appendix 3. Teacher Survey: Section Two item assignment across QS'**

| Topic | Correct form | Incorrect form | QSA | QSB |
|---|---|---|---|---|
| Group work: Individual Accountability | Group work is more effective in raising achievement if group members are given equal accountability | Group work is more effective in raising achievement if group members are given different levels of accountability | Incorrect | Correct |
| Group work: Common Group Goals | To make group work effective, group members should be working towards a common goal | To make group work effective in raising achievement, group members need not be working towards a common goal | Correct | Incorrect |
| Learning styles (neuromyth) | Aligning teaching strategies to fit with a learners preferred learning style will not enhance student achievement | Aligning teaching strategies to fit with a learners preferred learning style will enhance student achievement | Correct | Incorrect |
| Learning styles (neuromyth) | Learners who prefer to learn visually will not learn better when information is provided in a visual way | Learners who prefer to learn visually will learn better when information is provided in a visual way | Incorrect | Correct |
| Hemispheric differences (neuromyth) | Using co-ordination exercises to integrate left and right hemispheric brain functions will not improve student achievement | Using co-ordination exercises to integrate left and right hemispheric brain functions will improve student achievement | Incorrect | Correct |

| | | | | |
|---|---|---|---|---|
| Hemispheric differences (neuromyth) | Aligning teaching strategies to fit in with a student's brain hemispheric dominance will not enhance student achievement | Aligning teaching strategies to fit in with a student's brain hemispheric dominance will enhance student achievement | Correct | Incorrect |
| Assessment | Testing student knowledge of a topic prior to teaching will raise achievement more than providing reading material | Testing student knowledge of a topic prior to teaching will not raise achievement more effectively than providing reading material | Correct | Incorrect |
| Assessment | Providing feedback following formative assessment is  important to raise student achievement | Providing feedback following formative assessment is not important to raise student achievement | Incorrect | Correct |
| Metacognition | Teaching students how to monitor their own academic development will enhance attainment | Teaching students how to monitor their own academic development will not enhance attainment | Incorrect | Correct |
| Metacognition | Increasing students' awareness of different learning strategies will enhance achievement | Increasing students' awareness of different learning strategies will not enhance achievement | Correct | Incorrect |
| Ability grouping: Within-class | Grouping students within classes based on academic achievement is not an effective way to raise achievement | Grouping students within classes based on academic achievement is an effective way to raise achievement | Incorrect | Correct |
| Ability grouping: Between- class | Grouping students in to classes based on their ability is detrimental to the attainment of low- and mid-achieving students | Grouping students in to classes based on their ability is not detrimental to the attainment of low- and mid-achieving students | Correct | Incorrect |

| | | | | |
|---|---|---|---|---|
| Massed vs. spaced practice: knowledge acquisition | Students will learn more if taught across three daily 1-hour sessions than a single 3-hour session | Students will learn more if taught through a single 3-hour session than three daily 1-hour sessions | Incorrect | Correct |
| Massed vs. spaced practice: knowledge retention | Students will remember more if a set learning time is spread over a long time-period rather than condensed into a short time-period | Students will remember more if a set learning time is condensed into a short time-period rather than spread over a long time-period | Correct | Incorrect |
| Note-taking | Achievement will be enhanced if students take notes when learning | Achievement will not be enhanced if students take notes when learning | Incorrect | Correct |
| Note-taking | Structured note-taking strategies are more effective than unstructured note-taking strategies | Structured and unstructured note-taking strategies are equally effective in raising student achievement | Correct | Incorrect |
| Homework | Homework is effective in raising attainment only if teacher feedback is given | Homework is effective in raising attainment regardless of whether teacher feedback is given | Correct | Incorrect |
| Homework | More time spent completing homework will enhance achievement | More time spent completing homework will not enhance achievement | Incorrect | Correct |
| Brain training (neuromyth) | Cognitive benefits of brain-training games are not transferable to classroom learning | Cognitive benefits of brain-training games are transferable to classroom learning | Correct | Incorrect |
| Brain training (neuromyth) | Movement activities that encourage parts of the brain work together will not impact student achievement | Movement activities that encourage parts of the brain work together will positively impact student achievement | Incorrect | Correct |
| Direct instruction | Providing students with learning objectives before learning will improve student achievement | Providing students with learning objectives before learning will not improve student achievement | Incorrect | Correct |

| | | | | |
|---|---|---|---|---|
| Direct instruction | Setting challenging but realistic goals for students will raise achievement | Setting challenging but realistic goals for students will not raise achievement | Correct | Incorrect |
| Feedback | Students must perceive praise to be sincere for it to positively influence achievement | Student praise will effectively raise achievement regardless of perceived sincerity | Correct | Incorrect |
| Feedback | Feedback that provides learners with a goal will raise achievement | Feedback that provides learners with a goal will not raise achievement | Incorrect | Correct |
| Practice | Allowing students to practice will increase the transferability of those skills to new situations | Allowing students to practice will not increase the transferability of those skills to new situations | Incorrect | Correct |
| Practice | Students' retention of learned material will be enhanced by practising it | Students' retention of learned material will not be enhanced by practising it | Correct | Incorrect |

**Appendix 4. Invitation to participate**

Dear XX,

As you probably know, schools are coming under increased pressure to use research. However, there are several questions that remain unanswered. For example, how aware are teachers of research findings? Does the use of research findings lead to improved student learning outcomes?

To answer these questions, we are doing a large-scale survey across carefully selected secondary schools in England to identify the extent to which engagement with research can impact teachers' knowledge of teaching & learning principles, teachers' professional practice, and student achievement. We would like XX to participate in this research. This study will entail:

- A short fixed-choice (true/false) questionnaire to identify teachers' awareness of the impact of teaching and learning principles on student achievement. This will be an online questionnaire; all fully-qualified (i.e., QTS/ QTLS) teaching staff will be invited to participate.
- A separate survey with the person responsible for teachers' professional development (or, if applicable, research co-ordinator) to identify ways in which your school engages with educational research.

In return for your participation, you will receive:

- A school-specific summary of the investigation findings
- A full summary of the investigation findings across all participating schools.

If you wish for XX to participate, please reply 'yes' to this email. You will then receive a link to the questionnaire and be asked to distribute it across all teaching staff. You will also be asked to provide an email address for the person responsible for teachers' professional development within your school.

If you have any questions about this investigation, please contact Scott Clarke (clarkes@edgehill.ac.uk). Please accept my apologies if you have previously received this correspondence.

Yours Sincerely,

Tim Cain, PhD, Professor in Education, Director of studies
Victor van Daal, PhD, Professor in Education, Doctoral supervisor
David Allan, PhD Education, Doctoral supervisor
Scott Clarke (BSc, MSc, MA, PGCE, QTLS), PhD Candidate
Faculty of Education
Edge Hill University
L39 4QP

**Appendix 5. School Survey respondent professional demographics**

| Highest Qual. | Freq (%) | Managerial Responsibilities | Freq (%) | Job Title | Freq (%) |
|---|---|---|---|---|---|
| Undergrad. Degree (e.g., BSc) | 5 (12.2) | None | 0 (0) | Classroom Teacher/ Head of Dept. | 3 (7.3) |
| PGCE (or equiv.) | 14 (34.1) | Middle Management | 5 (12.2) | Assistant Headteacher | 25 (61) |
| Post-grad. Degree (e.g., MA, | 19 (46.3) | SMT | 36 (87.8) | Deputy Headteacher | 9 (22) |
| PhD or equiv.) | 3 (7.3) | | | Headteacher | 4 (9.8) |

## Appendix 6. Teacher Survey respondent professional demographics

| Age (Years) | Freq. (%) | National Statistic (%) | Highest Qualification | Frequency (%) | National Statistic (%) | Teaching Experience (Number of years) | Frequency (%) | Job Title | Frequency (%) | National Statistic (%) | Subject Specialism | Frequency (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| <21 | 0 (0) | | Undergrad. Degree (e.g., BSc) | 47 (11.1) | 24.0 | <1 year | 15 (3.5) | NQT | 18 (4.2) | 9.3 | English | 72 (16.9) |
| 21-30 | 91 (21.4) | *22.1 | PGCE (or equivalent) | 285 (67.1) | | 1-3 years | 48 (11.3) | Classroom Teacher | 220 (51.6) | 79.6 | Maths | 72 (16.9) |
| 31-40 | 138 (32.4) | 35.1 | Post-grad. Degree (e.g., MA) | 83 (19.5) | *70.5 | 4-7 years | 74 (17.4) | Assistant Head of Dept./Year | 32 (7.5) | Data not available | Physical Sciences (e.g., Biology) | 70 (16.4) |
| 41-50 | 133 (31.2) | 25.8 | PhD (or equivalent) | 10 (2.4) | 0.7 | 8-11 years | 74 (17.4) | Head of Dept./Year | 99 (23.2) | Data not available | Social Sciences (e.g. Sociology) | 12 (2.8) |
| 51-60 | 56 (13.1) | 14.8 | | | | +12 years | 214 (50.2) | Assistant/ Dep. Headteacher | 30 (7.0) | 9.3 | Vocational (e.g., H&S Care) | 6 (1.4) |
| 60+ | 7 (1.6) | 1.9 | | | | | | Headteacher | 2 (0.5) | 1.8 | PE/ Performing Arts/ Music | 73 (17.1) |
| | | | | | | | | Other | 24 (5.6) | Data not available | Humanities (e.g., History) | 69 (16.2) |
| | | | | | | | | | | | MFL/ DT | 30 (7.0) |

| | |
|---|---|
| ICT/ Business Studies | 21 (4.9) |

* - Data in this cell is inclusive of the above cell. This was necessary due to DfE grouping procedure.

**Appendix 7A. Descriptive statistics for School Survey items**

Item 3: Our school leaders take evidence from research findings into account when ... (tick all that apply)

| | Number of respondents | % of respondents |
|---|---|---|
| Creating policy | 29 | 76.3 |
| Implementing new initiatives | 35 | 92.1 |
| Deploying resources | 14 | 36.8 |
| None of the above | 2 | 5.3 |
| Other | 1 | 2.6 |

Number of ways research is used - M = 2.08; SD = 0.84; 95% CI = 1.80 - 2.36; range = 0 - 3
Standardised number of ways research is used - M = 5.20; SD = 2.11; 95% CI = 4.51 - 5.89; range = 0 - 7.5
Importance of using research - M = 4.63; SD = 0.63; 95% CI = 4.42 - 4.84; range = 2 - 5

Item 4: To support teachers in conducting research, our school provides... (tick all that apply)

| | Number of respondents | % of respondents |
|---|---|---|
| Financial support | 11 | 28.9 |
| Allocated research time | 18 | 47.4 |
| Access to academic resources | 14 | 36.8 |
| Access to a research mentor | 12 | 31.6 |
| Support from a Research-lead (or similar) | 14 | 36.8 |
| None of the above | 9 | 23.7 |
| Other | 0 | 0 |

Provisions offered by our school - M = 1.84; SD = 1.32; 95% CI = 1.41 - 2.28; range = 0 - 5
Standardised provisions offered by our school - M = 3.07; SD = 2.20; 95% CI = 2.35 - 3.79; range = 0 - 8.33
Importance of provisions - M = 4.42; SD = 0.69; 95% CI = 4.19 - 4.65; range = 3 - 5

Item 5: To support teachers in using research, our school provides... (tick all that apply)

| | Number of respondents | % of respondents |
|---|---|---|
| Allocated research time | 17 | 44.7 |
| Access to academic resources | 15 | 39.5 |
| Access to a research mentor | 9 | 23.7 |
| Support from a Research-lead (or similar) | 14 | 36.8 |
| Access to research-focused training | 13 | 34.2 |

| | | |
|---|---|---|
| Research reading groups | 7 | 18.4 |
| None of the above | 5 | 13.2 |
| Other | 0 | 0 |

Support provided by school - M = 2.01; SD = 1.32; 95% CI = 1.58 - 2.45; range = 0 - 5
Standardised support provided by school - M = 2.88; SD = 1.88; 95% CI = 2.26 - 3.49; range = 0 - 6.43
Importance of support - M = 4.51; SD = 0.64; 95% CI = 4.30 - 4.72; range = 3 - 5

Item 6: To what extent does your school encourage groups of staff (e.g. departments) to use research when making decisions?

| | Number of respondents | % of respondents |
|---|---|---|
| 1 (Rarely) | 3 | 7.9 |
| 2 | 6 | 15.8 |
| 3 | 6 | 15.8 |
| 4 | 10 | 26.3 |
| 5 (Often) | 13 | 34.2 |

Extent of encouragement - M = 3.62; SD = 1.33; 95% CI = 3.18 - 4.06; range 1 - 5
Standardised extent of encouragement - M = 7.24; SD = 2.67; 95% CI = 6.36 - 8.11; range = 2 - 10
Importance of encouraging groups of staff - M = 4.51; SD = 0.79; 95% CI = 4.25 - 4.77; range = 1 - 5

Item 7: Does the school in which you work employ a Research-lead (or equivalent)?

| | Number of respondents | % of respondents |
|---|---|---|
| Yes | 20 | 52.6 |
| No | 18 | 47.3 |

Importance of position - M = 3.84; SD = 1.10; 95% CI = 3.48 - 4.20; range = 1 - 5

Item 8: The person responsible for teachers' professional development regularly communicates with all teaching staff to provide...*

| | Number of respondents | % of respondents |
|---|---|---|
| CPD opportunities | 17 | 44.7 |
| Research-based academic resources | 2 | 5.3 |
| Opportunities to become involved in research with other schools | 6 | 15.8 |
| Opportunities to collaborate with colleagues in research activity | 9 | 23.7 |
| Opportunities to become involved in research projects with universities | 2 | 5.3 |

| | | |
|---|---|---|
| Other | 2 | 5.3 |

* Item incorrectly distributed as a single-choice response hence no item-total score.
Importance of communication with teaching staff - M = 4.50; SD = 0.64; 95% CI = 4.25 - 4.75; range = 3 - 5

Item 9: How regularly does the person responsible for teachers' professional development communicate with HE institutions and/or external bodies (e.g., Education Endowment Foundation)?

| | Number of respondents | % of respondents |
|---|---|---|
| 1 (No Regular Contact) | 6 | 2.6 |
| 2 | 8 | 21.1 |
| 3 | 9 | 23.7 |
| 4 | 11 | 28.9 |
| 5 (Highly Regular Contact) | 4 | 10.5 |

Regularity of communication - M = 2.96; SD = 1.25; 95% CI = 2.55 - 3.37; range 1 - 5
Standardised regularity of communication - M = 5.92; SD = 2.51; 95% CI = 5.10 - 6.75; range 2-10
Importance of communication - M = 3.87; SD = .71; 95% CI = 3.63 - 4.10; range = 2 - 5

Item 10: Research is used within our school to create a culture of... (tick all that apply)

| | Number of respondents | % of respondents |
|---|---|---|
| Reflectivity | 27 | 71.1 |
| Creativity | 22 | 57.8 |
| Criticality | 12 | 31.5 |

Research uses - M = 1.67; SD = .90; 95% CI = 1.37 - 197; range = 0 - 3
Standardised research uses - M = 4.18; SD = 2.26; 95% CI = 3.44 - 4.92; range = 0 - 7.50
Importance of research uses - M = 4.05; SD = 0.84; 95% CI = 3.87 - 4.33; range = 2 - 5

Item 11: To what extent are teachers are encouraged to consider research that challenges their conceptions about T&L?

| | Number of respondents | % of respondents |
|---|---|---|
| 1 (Rarely Encouraged) | 0 | 0 |
| 2 | 9 | 23.7 |
| 3 | 4 | 10.5 |

| | | |
|---|---|---|
| 4 | 11 | 28.9 |
| 5 (Strongly Encouraged) | 14 | 36.8 |

Regularity of encouragement - M = 3.75; SD = 1.18; 95% CI = 3.36 - 4.14; range 2 - 5
Standardised regularity of encouragement - M = 7.50; SD = 3.36; 95% CI = 6.73 – 8.27; range 4 - 10
Importance of encouragement - M = 4.24; SD = .70; 95% CI = 4.01 – 4.47; range = 2 – 5

Item 12: How many teachers are involved in the following activities... (tick all that apply)

| | None | Some Teachers | Most Teachers | All Teachers |
|---|---|---|---|---|
| School-based research conferences | 9 (23.7) | 24 (63.2) | 4 (10.5) | 1 (2.6) |
| School-based publications | 11 (28.9) | 21 (55.3) | 2 (5.3) | 4 (10.5) |
| School-based CPD days | 1 (2.6) | 5 (13.2) | 2 (5.3) | 30 (78.9) |
| Regular staff briefings | 2 (5.3) | 2 (5.3) | 3 (7.9) | 31 (81.6) |
| Research reading groups | 22 (57.9) | 13 (34.2) | 2 (5.3) | 1 (2.6) |
| No research activity | 13 (34.2) | 18 (47.4) | 7 (18.4) | 1 (2.6) |
| Other | 32 (84.2) | 2 (5.3) | 1 (2.6) | 3 (7.9) |
| Totals (M; SD) | 2.05; 1.07 | 1.78; 0.96 | 0.36; 0.50 | 2.05; 2.15 |

Number of teachers engaged in research activities - M = 2.05; SD = 2.15; 95% CI = 1.34 - 2.77; range = -2 - 6
Standardised number of teachers engaged in research activities - M = 4.11; SD = 4.36; 95% CI = 2.67 - 5.54; range = -4 - 12
Importance of teacher engagement in research activities - M = 4.37; SD = 0.73; 95% CI = 4.12 - 4.61; range = 2 - 5

Item 13: To what extent are collaborations with external partners used purposely to challenge teachers' conceptions about T&L?

| | Number of respondents | % of respondents |
|---|---|---|
| 1 (None) | 1 | 2.6 |
| 2 | 9 | 23.7 |
| 3 | 13 | 34.2 |
| 4 | 8 | 21.1 |
| 5 (A lot) | 7 | 18.4 |

| |
|---|
| Regularity of collaboration - M = 3.29; SD = 1.11; 95% CI = 2.92 - 3.66; range = 1 - 5<br>Standardised regularity of collaboration - M = 6.58; SD = 2.20; 95% CI = 5.85 - 7.31; range = 2 - 10<br>Importance of collaboration - M = 4; SD = 0.83; 95% CI = 3.73 - 4.27; range = 2 - 5 |

Item 14: Our school has the following quality assurance procedures in place to ensure that research we conduct is high-quality... (tick all that apply)

| | Number of respondents | % of respondents |
|---|---|---|
| Access to an academic mentor | 6 | 15.8 |
| Research proposals must be accepted | 6 | 15.8 |
| Provide access to academic resources | 11 | 28.9 |
| Conduct workshops for researchers | 8 | 21.1 |
| Communication with a teaching school | 13 | 34.2 |
| Our school has no quality assurance procedures to ensure research quality | 17 | 44.7 |
| Other | 3 | 7.9 |
| Number of quality assurance procedures - M = 1.20; SD = 1.24; 95% CI = 0.82 - 2.24; range = 0 - 5<br>Standardised number of quality assurance procedures - M = 2.00; SD = 2.04; 95% CI = 1.32 - 2.67; range = 0 - 7.50<br>Importance of quality assurance procedures - M = 4.38; SD = .82; 95% CI = 3.76 – 4.85; range = 2 – 5 | | |

Item 15: To what extent is research used as a tool to promote professional dialogue amongst teachers?

| | Number of respondents | % of respondents |
|---|---|---|
| 1 (Not at all) | 0 | 0 |
| 2 | 7 | 18.4 |
| 3 | 7 | 5.3 |
| 4 | 21 | 53.3 |
| 5 (A lot) | 3 | 7.9 |
| Extent of research use for this purpose - M = 3.50; SD = 0.89; 95% CI = 3.21 - 3.79; range = 2 - 5<br>Standardised extent of research use for this purpose - M = 7.00; SD = 1.77; 95% CI = 6.42 - 7.58; range = 4 - 10<br>Importance of research use for this purpose - M = 4.33; SD = .78; 95% CI = 4.07 – 4.59; range = 2 – 5 | | |

Item 16: Our school supports all teachers in undertaking post-graduate study through... (tick all that apply)

| | Number of respondents | % of respondents |
|---|---|---|
| Financial support | 16 | 42.1 |
| Allocated study time | 8 | 21.1 |
| Providing a mentor | 9 | 23.7 |
| Additional CPD opportunities | 21 | 55.3 |
| Our school does not support teachers in undertaking post-graduate study | 9 | 23.7 |
| Other | 0 | 0 |
| Support provided by school - M = 1.41; SD = 1.12; 95% CI = 1.04 - 1.78; range = 0 - 4 | | |
| Standardised support provided by school - M = 2.82; SD = 2.21; 95% CI = 2.08 - 3.55; range = 0 - 8 | | |
| Importance of support - M = 3.76; SD = 1.05; 95% CI = 3.42 - 4.11; range = 2 -5 | | |

Item 17: Our school has the following quality assurance procedures in place to ensure that research we use is high-quality... (tick all that apply)

| | Number of respondents | % of respondents |
|---|---|---|
| Access to an academic mentor | 2 | 5.3 |
| Access to academic journals | 10 | 26.3 |
| Research focused workshops | 11 | 28.9 |
| Communication with a teaching school | 11 | 28.9 |
| Research must meet specific methodological criteria | 3 | 7.9 |
| Our school has no quality assurance procedures in place to ensure research used is high quality | 18 | 47.4 |
| Other | 0 | 0 |
| Number of quality assurance procedures - M = .95; SD = 0.99; 95% CI = 0.62 - 1.27; range = 0 -4 | | |
| Standardised number of quality assurance procedures - M = 1.58; SD = 1.65; 95% CI = 1.04 - 2.12; range = 0 - 5.83 | | |
| Importance of quality assurance procedures - M = 4.14; SD = 0.74; 95% CI = 3.90 - 4.39; range = 2 - 5 | | |

**Appendix 7B. Descriptive statistics for Teacher Survey items**

Item 9: How appropriately can educational research findings be used to guide general educational practice?

| | Number of respondents | % of respondents |
|---|---|---|
| 1 (Not Appropriate) | 2 | 0.5 |
| 2 | 19 | 4.3 |
| 3 | 81 | 18.3 |
| 4 | 246 | 55.7 |
| 5 (Highly Appropriate) | 77 | 17.4 |
| Appropriateness of educational research – M = 3.89; SD = .76; 95% CI = 3.81 – 3.96 | | |

Item 9A: For what reason(s) do you consider educational research findings to be inappropriate for guiding educational practice?

| | Number of respondents | % of respondents |
|---|---|---|
| Methodological concerns | 202 | 47.5 |
| Zero reasons | 101 | 23.8 |
| Practical obstacles | 48 | 11.3 |
| Disparity between theory & practice | 32 | 7.5 |
| Other | 30 | 7.1 |
| Alternative agenda of educational research | 12 | 2.8 |

Item 9B: What are the benefits of using educational research findings to guide educational practice?

| | Number of respondents | % of respondents |
|---|---|---|
| Facilitate evidence-based practice | 215 | 50.6 |
| Enhance reflective processes | 150 | 35.3 |
| Professionally desirable | 32 | 7.8 |
| Zero benefits | 11 | 2.6 |
| Other | 13 | 3.1 |

Item 10: To what extent is your teaching practice influenced by educational research findings?

| | Number of respondents | % of respondents |
|---|---|---|
| 1 (Not Influenced) | 4 | 0.9 |
| 2 | 63 | 14.8 |
| 3 | 171 | 40.2 |
| 4 | 59 | 37.4 |
| 5 (Highly Influenced) | 28 | 6.6 |
| Influence of educational research – M = 3.34; SD = .84; 95% CI = 3.26 – 3.42 | | |

Item 10A: In what ways do educational research findings influence your practice?
N/A

Item 10B: What obstacles do you face in using educational research findings to influence your practice?

| | Number of respondents | % of respondents |
|---|---|---|
| Time | 187 | 44.0 |
| Research validity | 90 | 21.2 |
| Access | 69 | 16.2 |
| Implementation | 42 | 9.9 |
| Zero obstacles | 16 | 3.7 |
| Other | 21 | 4.8 |

Item 11: What resources do teachers typically use to remain research-informed? (Tick all that apply)

| | Number of respondents | % of respondents |
|---|---|---|
| Academic journals | 120 | 27.1 |
| Discussion with peers | 374 | 84.6 |
| Social networking | 285 | 64.5 |
| Books | 181 | 41 |
| TV/ Newspaper | 188 | 42.5 |
| Membership to professional bodies | 177 | 40 |
| No resources utilised | 10 | 2.3 |
| Other | 0 | 0 |
| Total number of resources selected – M = 3.12; SD = 1.33; 95% CI = 2.99 – 3.24; range = 0 – 6 | | |

Item 12: What steps do teachers take to maintain educational research currency? (Tick all that apply)

| | Number of respondents | % of respondents |
|---|---|---|
| Further study | 55 | 12.4 |
| School-based CPD | 382 | 86.4 |
| HE research collaborations | 58 | 13.1 |
| School-based research collaborations | 131 | 29.6 |
| No steps taken | 19 | 4.3 |
| Other | 5 | 1.1 |
| Total number of steps taken – M = 1.47; SD = 0.79; 95% CI = 1.40 – 1.55; range = 0 – 4 | | |

**Appendix 8. Teacher Survey: Section Two significant inter-item correlations**. (C = correct item form; I = incorrect item form)

| **QSA** | | **QSB** | | | |
|---|---|---|---|---|---|
| Item | Positive | Negative | Item | Positive | Negative |
| Homework 1C | | | Homework 2C | DI 1C | Feedback 1I<br>Feedback 2C<br>Homework 1I<br>Learning Styles 2C |
| Homework 2I | | Brain Training 1C<br>Hemispheric differences 2C<br>Learning Styles 1C<br>Learning Styles 2I<br>Feedback 1C<br>Ability grouping 1I | Homework 1I | Ability grouping 2I | Feedback 2C<br>Homework 2C |
| Brain Training 1C | Brain Training 2I<br>Hemispheric differences 1I<br>Hemispheric differences 2C<br>Learning Styles 1C<br>Learning Styles 2I<br>Ability grouping 2C<br>Group work 1I | Homework 2I<br>Metacog 2C<br>DI 1I<br>Feedback 2I | Brain Training 1I | Massed vs Spaced 2I<br>Hemispheric differences 2I<br>Feedback 1I<br>Learning Styles 1I<br>Learning Styles 2C<br>Brain Training 2C<br>Note-taking 2I | Practice 1C |
| Brain Training 2I | Hemispheric differences 1I | Metacog 2C | Brain Training 2C | Hemispheric differences 1C | Practice 1C |

| | | | | | |
|---|---|---|---|---|---|
| | Hemispheric differences 2C<br>Learning Styles 1C<br>Learning Styles 2I<br>Ability grouping 1I<br>Ability grouping 2C<br>Group work 1I | DI 2C<br>DI 1I<br>Feedback 2I | | Learning Styles 2C<br>Brain Training 1I | |
| Note-taking 1I | Practice 1I<br>Metacog 2C<br>Group work 1I | Ability grouping 1I<br>Ability grouping 2C | Note-taking 1C | Group work 1C | |
| Note-taking 2C | Feedback 2I<br>Practice 1I | | Note-taking 2I | Massed vs Spaced 2I<br>Hemispheric differences 2I<br>Brain training 1I | |
| Practice 1I | Massed vs Spaced 1I<br>Practice 2C<br>Metacog 1I<br>Feedback 1C<br>Feedback 2I<br>Group work 2C | | Practice 1C | Metacog 1C<br>Massed vs Spaced 1C<br>DI 1C<br>Assessment 2C<br>Group work 1C | Learning Styles 1I<br>Learning Styles 2C<br>Brain Training 1I<br>Brain Training 2C |
| Practice 2C | Metacog 1I<br>Practice 1I<br>DI 2C<br>Feedback 1C<br>Feedback 2I | | Practice 2I | Metacog 1C<br>Ability grouping 2I | |

| | | | | | |
|---|---|---|---|---|---|
| | Group work 2C | | | | |
| Hemispheric differences 1I | Hemispheric differences 2C<br>Brain Training 1C<br>Learning Styles 1C<br>Learning Styles 2I<br>Ability grouping 1I<br>Group work 1I | Metacog 2C<br>DI 1I | Hemispheric differences 1C | Massed vs Spaced 2I<br>Brain Training 2C | |
| Hemispheric differences 2C | Ability grouping 2C<br>Group work 1I<br>Brain Training 1C<br>Brain training 2I<br>Learning styles 1C<br>Learning styles 2I<br>Hemispheric differences 1I | Metacog 2C<br>DI 1I<br>Feedback 2I | Hemispheric differences 2I | Feedback 1I<br>Learning Styles 1I<br>Learning Styles 2C<br>Brain Training 1I<br>Group work 2I<br>Note taking 2I | Metacog 2I<br>DI 1C |
| Massed vs Spaced 1I | Practice 1I | | Massed vs Spaced 1C | Assessment 1I<br>Practice 1C | |
| Massed vs Spaced 2C | Group work 2C | Group work 1I | Massed vs Spaced 2I | Hemispheric differences 1C<br>Assessment 1I<br>Feedback 1I<br>Learning Styles 1I<br>Brain Training 1I<br>Note-taking 2I | |

| | | | | | |
|---|---|---|---|---|---|
| Metacog 2C | Note-taking 1I<br>DI 2C<br>DI 1I | Brain Training 1C<br>Brain Training 2I<br>Learning Styles 1C<br>Learning Styles 2I<br>Ability grouping 2C<br>Hemispheric differences 2C<br>Hemispheric differences 1I | Metacog 2I | Metacog 1C | Hemispheric differences 2I<br>Learning Styles 1I<br>Learning Styles 2C |
| Metacog 1I | Feedback 1C<br>Feedback 2I<br>Practice 1I<br>Practice 2C<br>Groping 1I | | Metacog 1C | Metacog 2I<br>Assessment 1I<br>Assessment 2C<br>Practice 1C<br>Practice 2I<br>Feedback 1I | |
| Assessment 1C | Feedback 1C<br>Feedback 2I<br>Group work 2C | | Assessment 1I | Metacog 1C<br>Massed vs Spaced 1C<br>Massed vs Spaced 2I<br>Assessment 2C<br>Feedback 2C<br>Group work 2I | |
| Assessment 2I | | | Assessment 2C | Practice 1C<br>Metacog 1C<br>Assessment 1I | |
| Learning Styles 1C | Learning Styles 2I | DI 1I | Learning Styles 1I | Massed vs Spaced 2I | Metacog 2I |

| | | | | | |
|---|---|---|---|---|---|
| | Ability grouping 1I | Homework 2I | | Hemispheric differences 2I | DI 1C |
| | Ability grouping 2C | Metacog 2C | | Feedback 1I | Practice 1C |
| | Group work 1I<br>Brain training 1C<br>Brain training 2I<br>Hemispheric differences 1I<br>Hemispheric differences 2C | | | Ability grouping 1C<br>Learning Styles 2C<br>Brain Training 1I<br>Group work 2I | |
| Learning Styles 2I | Learning Styles 1C | Homework 2I | Learning Styles 2C | Learning Styles 1I | Metacog 2I |
| | Ability grouping 1I | DI 1I | | Hemispheric differences 2I | DI 1C |
| | Ability grouping 2C | Metacog 2C | | Feedback 1I | Practice 1C |
| | Group work 1I<br>Brain Training 1C<br>Brain training 2I<br>Hemispheric differences 1I<br>Hemispheric differences 2C | | | Brain Training 1I<br>Brain Training 2C | Homework 2C |
| DI 2C | DI 1I | Group work 1I | DI 2I | | |
| | Feedback 1C | Brain Training 2I | | | |
| | Practice 2C | | | | |
| | Metacogntion 2C | | | | |
| DI 1I | Metacogntion 2C | Brain Training 2I | DI 1C | Practice 1C | Hemispheric differences 2I |

| | | | | | |
|---|---|---|---|---|---|
| | DI 2C<br>Feedback 2I<br>Group work 2C | Brain Training 1C<br>Ability grouping 1I<br>Ability grouping 2C<br>Hemispheric differences 1I<br>Hemispheric differences 2C<br>Learning Styles 1C<br>Learning styles 2I | | Homework 2C | Learning Styles 1I<br>Learning Styles 2C |
| Feedback 1C | Feedback 2I<br>Practice 1I<br>Practice 2C<br>Metacogntion 1I<br>Assessment 1C<br>DI 2C | Homework 2I | Feedback 1I | Metacog 1C<br>Massed vs Spaced 2I<br>Hemispheric differences 2I<br>Learning Styles 1I<br>Learning Styles 2C<br>Brain Training 1I | Homework 2C |
| Feedback 2I | Group work 2C<br>Note-taking 2C<br>Practice 1I<br>Practice 2C<br>Assessment 1C<br>DI 2C<br>DI 1I<br>Feedback 1C | Group work 1I<br>Brain Training 2I<br>Brain Training 1C | Feedback 2C | Assessment 1I | Homework 2C<br>Homework 1I |
| Ability grouping 1I | Ability grouping 2C<br>Brain training 2I | Homework 2I<br>Note-taking 1I | Ability grouping 1C | Ability grouping 2I<br>Learning Styles 1I | |

| | | | | |
|---|---|---|---|---|
| | Hemispheric differences 1I<br>Metacog 1I<br>Learning Styles 1C<br>Learning Styles 2I | DI 1I | | |
| Ability grouping 2C | Brain Training 1C<br>Brain Training 2I<br>Hemispheric differences 2C<br>Learning Styles 1C<br>Learning Styles 2I<br>Ability grouping 1I | Note-taking 1I<br>DI 1I | Ability grouping 2I | Practice 2I<br>Ability grouping 1C<br>Homework 1I |
| Group Work 2C | Practice 1I<br>Practice 2C<br>Massed vs Spaced 2C<br>Assessment 1C<br>DI 1I<br>Feedback 2I | | Group Work 2I | Hemispheric differences 2I<br>Assessment 1I<br>Learning Styles 1I |
| Group work 1I | Brain training 1C<br>Brain Training 2I<br>Note-taking 1I<br>Hemispheric differences 1I<br>Hemispheric differences 2C<br>Learning Styles 1C & 2I | Massed vs Spaced 2C<br>DI 2C<br>Feedback 2I | Group Work 1C | Practice 1C<br>Note-taking 1C |

**Appendix 9. Teacher Survey: Section Two factor analysis unrotated**

QSA

| Component | Eigenvalue | % of Variance | Cumulative % |
|---|---|---|---|
| 1 | 3.313 | 17.436 | 17.436 |
| 2 | 2.085 | 10.972 | 28.408 |
| 3 | 1.397 | 7.354 | 35.762 |
| 4 | 1.286 | 6.771 | 42.533 |
| 5 | 1.215 | 6.397 | 48.930 |
| 6 | 1.055 | 5.552 | 54.482 |
| 7 | .981 | 5.161 | 59.642 |
| 8 | .916 | 4.822 | 64.464 |
| 9 | .850 | 4.475 | 68.939 |
| 10 | .800 | 4.209 | 73.148 |
| 11 | .770 | 4.054 | 77.202 |
| 12 | .704 | 3.707 | 80.909 |
| 13 | .670 | 3.528 | 84.437 |
| 14 | .609 | 3.207 | 87.644 |
| 15 | .550 | 2.895 | 90.539 |
| 16 | .514 | 2.703 | 93.242 |
| 17 | .445 | 2.341 | 95.583 |
| 18 | .438 | 2.308 | 97.891 |
| 19 | .401 | 2.109 | 100.000 |

QSB

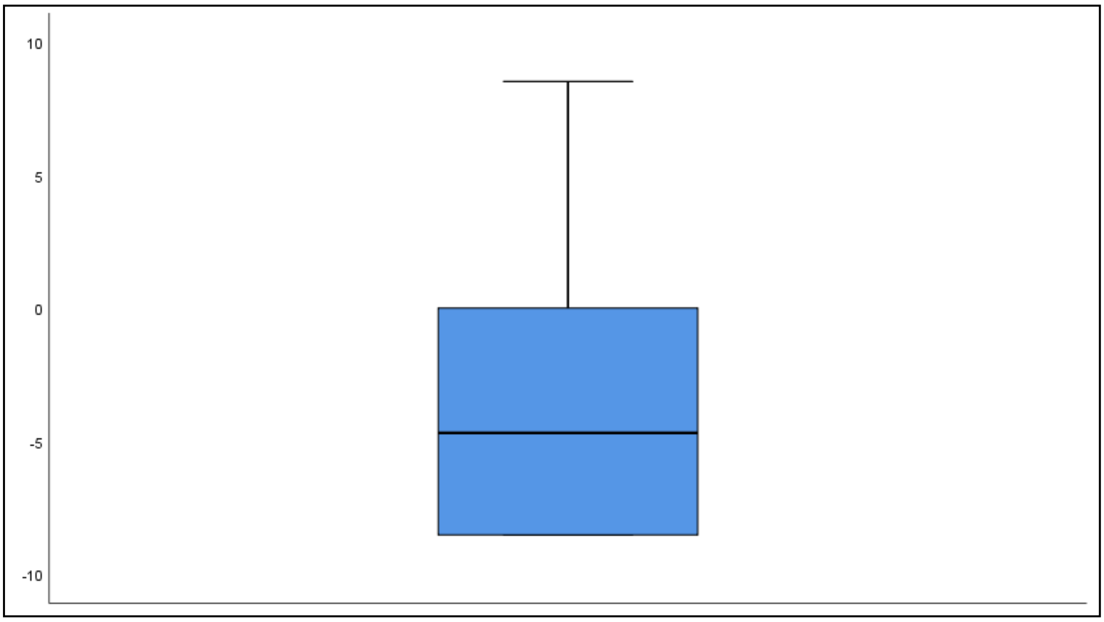
| Component | Eigenvalue | % of Variance | Cumulative % |
|---|---|---|---|
| 1 | 2.770 | 14.579 | 14.579 |
| 2 | 1.813 | 9.545 | 24.124 |
| 3 | 1.329 | 6.992 | 31.116 |
| 4 | 1.286 | 6.768 | 37.884 |
| 5 | 1.226 | 6.454 | 44.338 |
| 6 | 1.126 | 5.926 | 50.264 |
| 7 | 1.120 | 5.896 | 56.160 |
| 8 | 1.040 | 5.473 | 61.633 |
| 9 | .926 | 4.875 | 66.508 |
| 10 | .903 | 4.751 | 71.259 |
| 11 | .842 | 4.431 | 75.690 |
| 12 | .754 | 3.967 | 79.658 |
| 13 | .719 | 3.783 | 83.441 |
| 14 | .617 | 3.250 | 86.691 |
| 15 | .616 | 3.240 | 89.931 |
| 16 | .558 | 2.936 | 92.866 |
| 17 | .554 | 2.917 | 95.783 |
| 18 | .436 | 2.295 | 98.079 |
| 19 | .365 | 1.921 | 100.000 |

**Appendix 10. Teacher Survey: Section Two squared factor loading (> .35) (percentage of variance explained)**

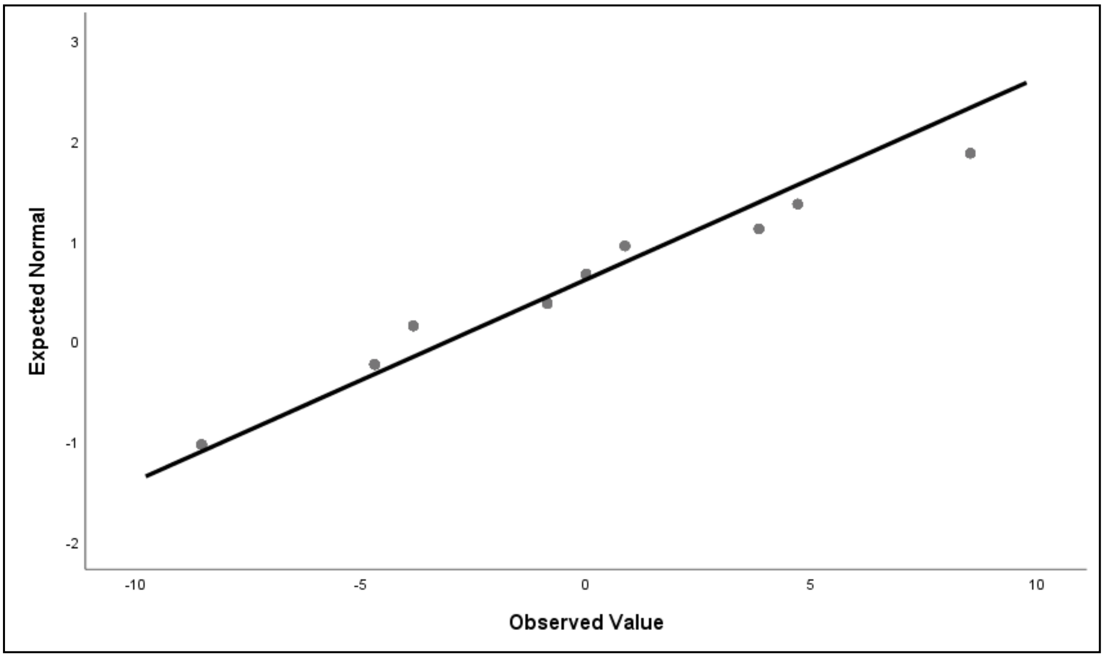
| QSA | Factor one | Factor two | QSB | Factor one | Factor two |
|---|---|---|---|---|---|
| Assessment 2I | | | Metacognition 1C | | .567 (32.1) |
| Group work 1I | .423 (18.2) | | Hemispheric 2I | .571 (32.6) | |
| Massed vs Spaced 2C | | | Assessment 1I | | .452 (20.4) |
| Brain Training 1C | .757 (57.3) | | Feedback 2C | | |
| Practice 1I | | .546 (31.8) | Assessment 2C | | .398 (15.8) |
| Ability grouping 2C | | | Practice 2I | | |
| Learning Styles 2I | .720 (51.8) | | Learning Styles 1I | .666 (44.3) | |
| Note-taking 2C | | | Massed vs Spaced 2I | | |
| Practice 2C | | .657 (43.1) | Hemispheric 1C | .372 (13.8) | |
| Feedback 1C | | .647 (41.8) | Group work 1C | | |
| Hemispheric 2C | .616 (37.9) | | Feedback 1I | | .457 (20.8) |
| Brain Training 2I | .694 (48.1) | | Practice 1C | | .389 (15.1) |
| Metacognition 1I | | .515 (26.5) | Ability grouping 1C | | |
| Assessment 1C | | | Ability grouping 2I | | .376 (14.1) |
| Learning Styles 1C | .685 (46.9) | | Learning Styles 2C | .660 (43.5) | |
| Feedback 2I | | .584 (34.1) | Brain Training 2C | .463 (21.4) | |
| Group work 2C | | .380 (14.4) | Group work 2I | | |
| Hemispheric 1I | .628 (39.4) | | Note-taking 2I | .410 (16.8) | |
| Ability grouping 1I | .358 (12.8) | | Brain training 1I | .580 (33.6) | |

**Appendix 11.** ***d'*** **and** ***C*** **data Q-Q plots and boxplots for factor one and factor two**

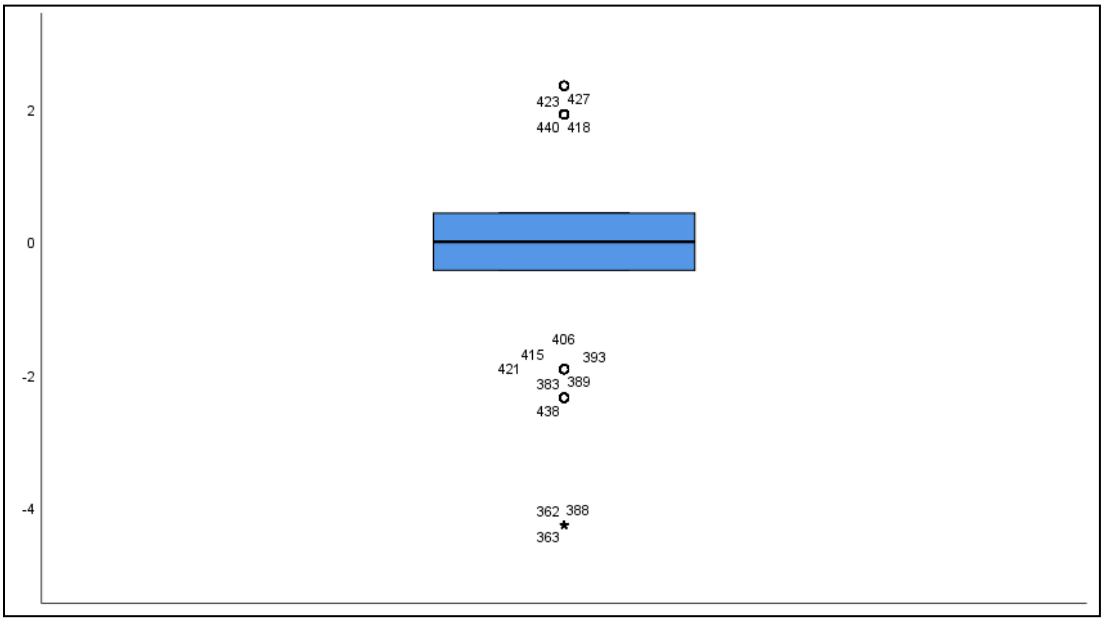
Factor one *d'* scores boxplot



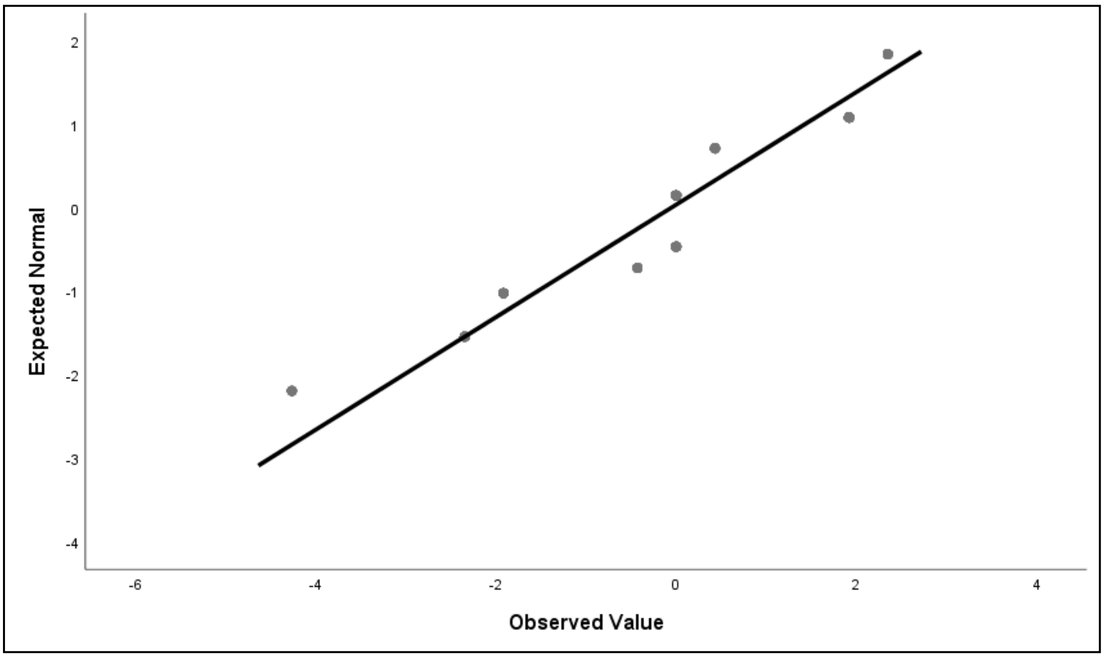

Factor one *d'* scores Q – Q plot



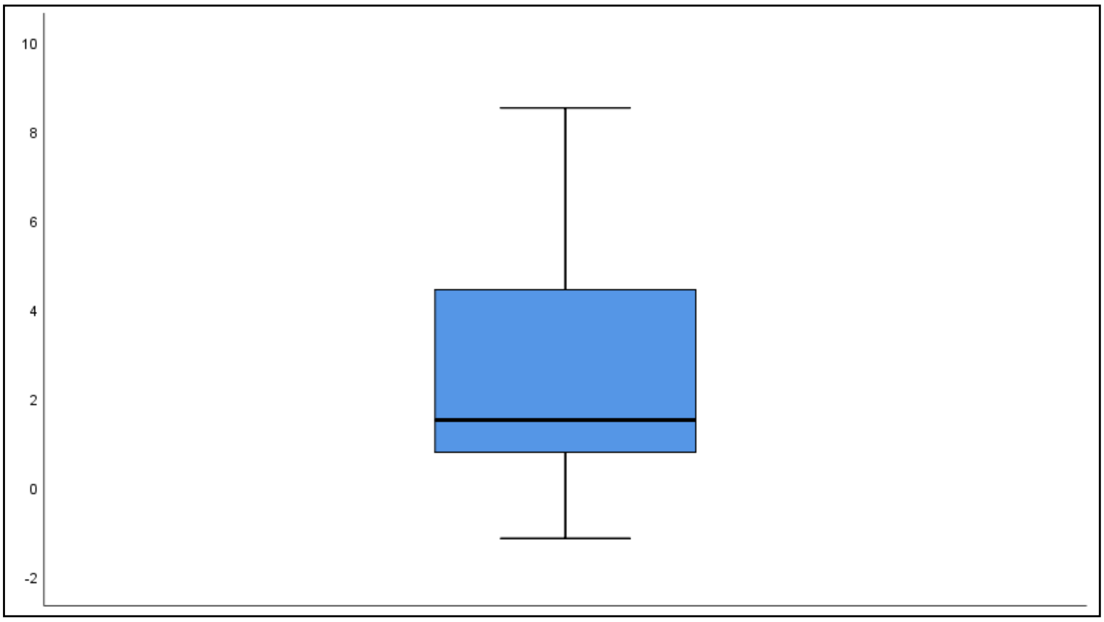
Factor one *C* scores boxplot



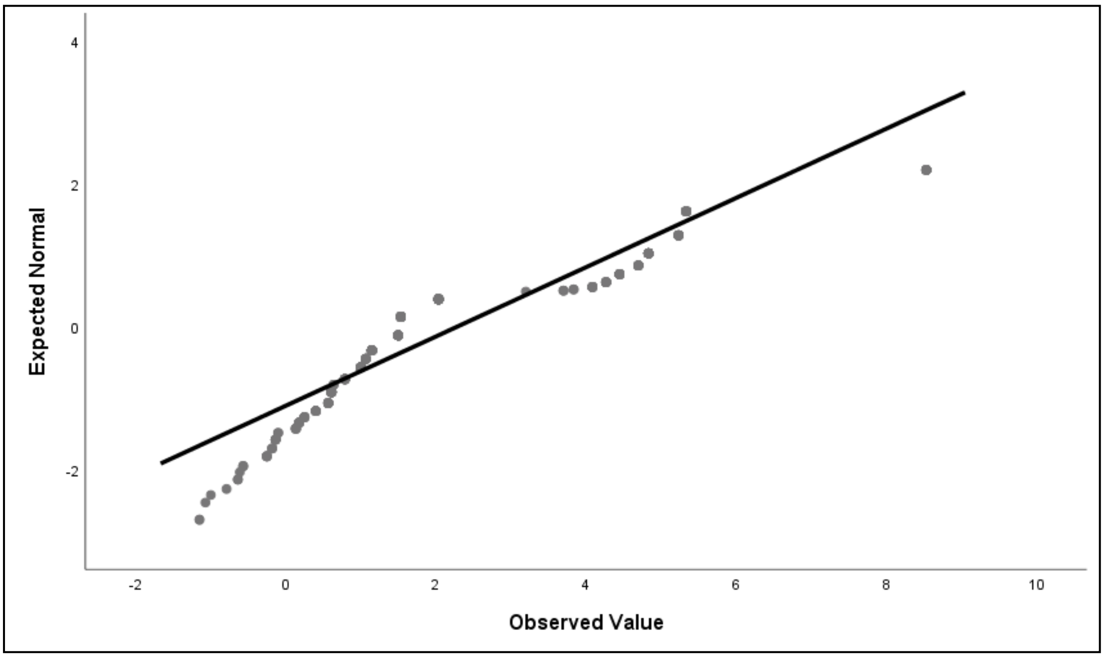

Factor one *C* scores Q – Q plot



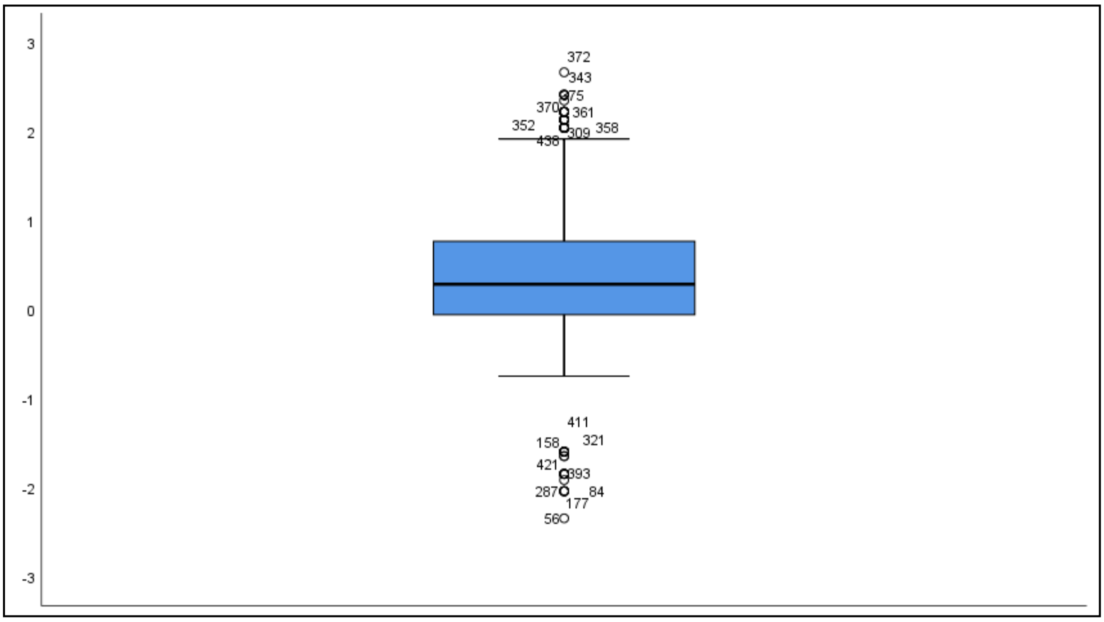
Factor two d’ scores boxplot



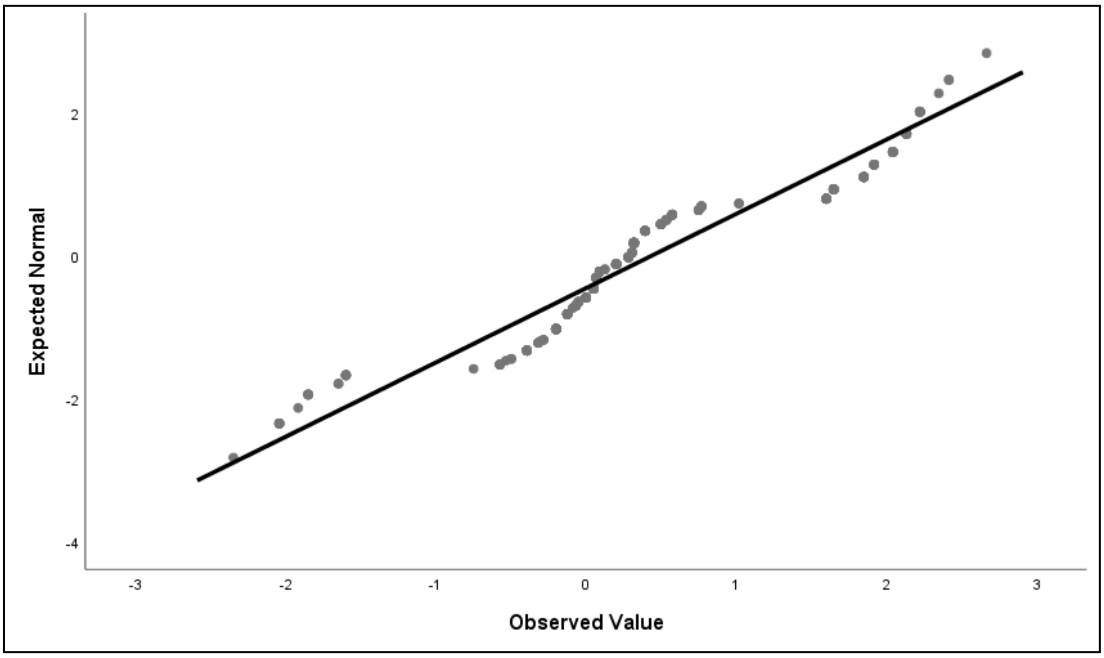

Factor two *d’* scores  Q – Q plot



Factor two *C* scores boxplot




Factor two *C* scores Q – Q plot



**Appendix 12. Relationship between RQ5 variables**